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Instruction Manual
F6 and N6 Cirulator including all Baths
(V 1.56/7)

Part No. 002-3575 F
1-1-044-2 / 09.2000

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1. Key to Symbols

1.1 Symbols used in this manual

! Warns the user of possible damage to the unit, draws attention to the risk of injury or contains safety notes and warnings.

☞ Denotes an important remark.

1 Indicates the next operating step to be carried out and ...

⇒ ... what happens as a result thereof.

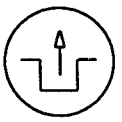
1.2 Symbols used on the unit (front)

Caution: Read the instruction manual before operating.

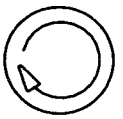
Instrument in "off" position.

Instrument in "on" position.

Adjustment for setting the cut-off point for excess temperature protection.



Reset after fault of the instrument.



Selection of the basic menu or return from any sub menu after settings have been made.

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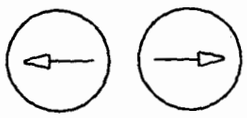
Key to Symbols

1.2.1 Value alteration



Selection of the digit which needs to be altered in any temperature or time displays. Can be made left or right.

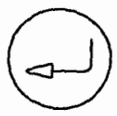
T-SELECT/SETPOINT	
SETPOINT:	+123.45°C
SET-NEW:	+123.45°C

The selected digit is underlined,
e.g. change of set value:
The one-degree digit has to be changed.

Change of the selected digit between 0 and 9,

T-SELECT/SETPOINT	
SETPOINT:	+123.45°C
SET-NEW:	+126.45°C

e.g. change of set value:
The temperature has been altered by 3°C.



ENTER key to confirm a selection,

T-SELECT/SETPOINT	
SETPOINT:	+126.45°C
SET-NEW:	+126.45°C

e.g. change of set value:
The set value alteration of plus 3°C
has been confirmed and is in action.

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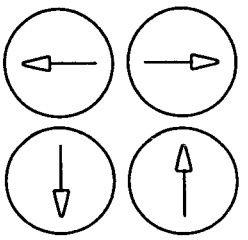
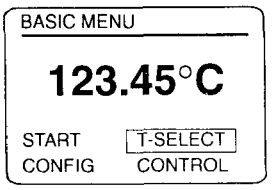
Key to Symbols

1.2.2 Menu selection

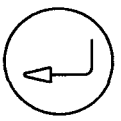


Any single menu point in a menu display (monitor contents) can be selected by using the arrow keys.

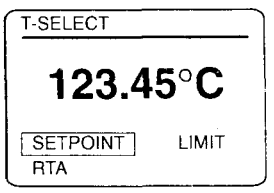


The selected menu point will be marked.

e.g. T-SELECT



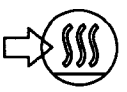
ENTER key to confirm a selection and to change to the next menu.



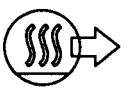
The next menu appears
e.g. SETPOINT

1.3 Symbols used on the unit (rear)

W Connection for tap water cooling.



Pump connection: back flow (suction) from the external object.



Pump connection: pressure to the external object.

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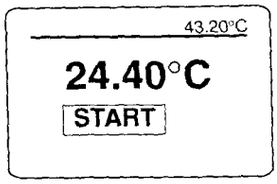
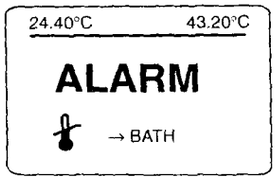
Key to Symbols

1.4 Symbols used on the display



START flashes and reminds to perform the starting procedure. Select with ◎ the basic menu, then select START and press ↵ ENTER.



ALARM flashes and heater element, pump and if available, cooling circuit have been switched off. Any cause of the alarm is displayed in a second line.

Lights up if heater is active and flashes during the control phase.

1

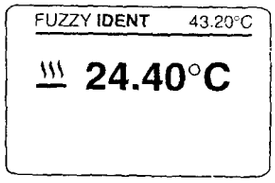
Lights up if cooling is active with full cooling capacity.

2

Lights up if cooling is active with partial cooling capacity.

Star 1 and 2 are blinking alternately when the cooling is on.

The crossed out star is on when the cooling unit is off.



IDENT flashes: After switching on the unit or entering a new set temperarture, the FuzzyStar® controller determines suitable control parameters. It can happen that heating or cooling is interrupted during this process and the displayed temperature changes. This is because the control unit requires some time to determine the parameters.

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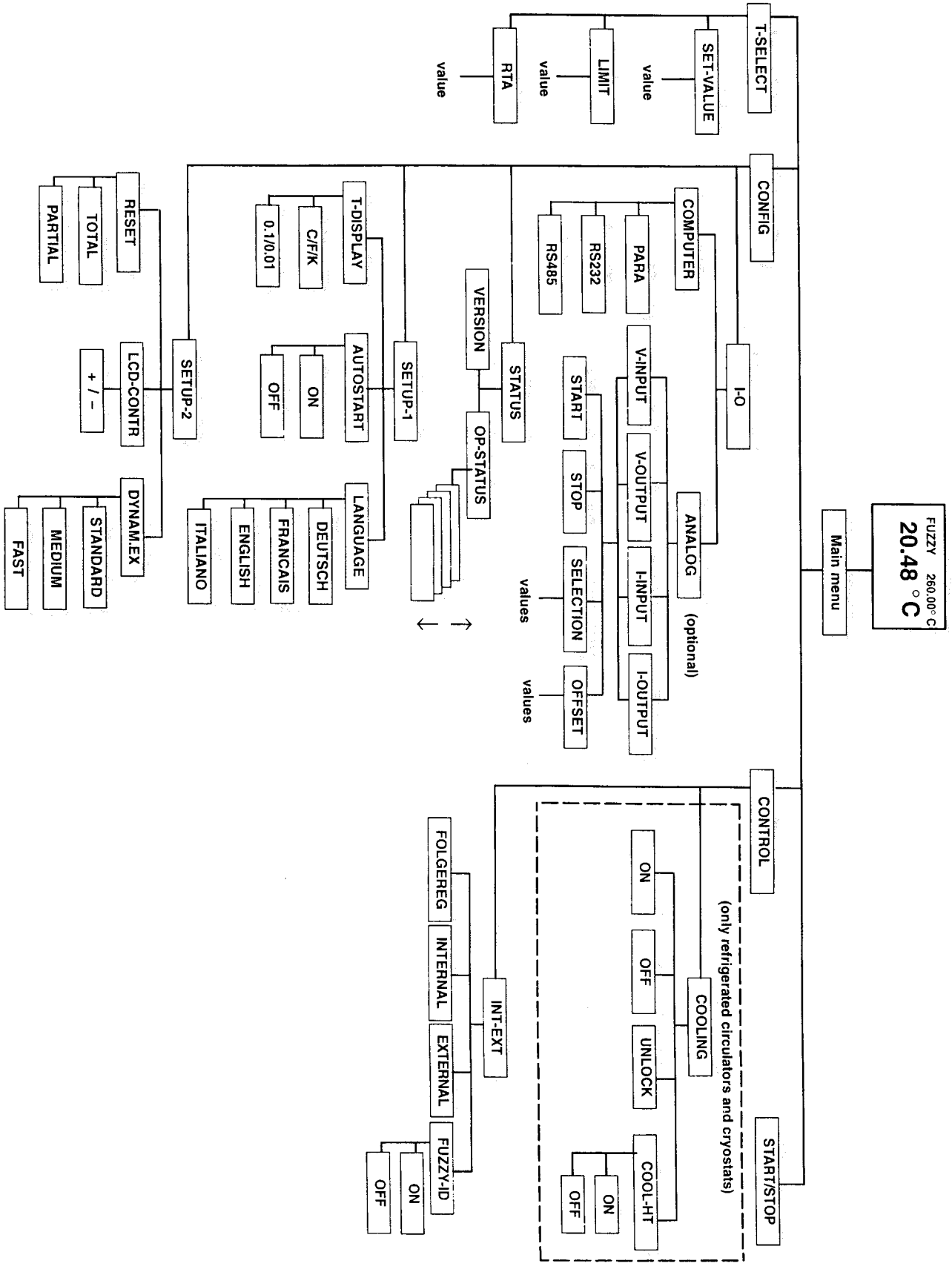
Key to Symbols

1.5 Menu Tree



2. Quality Assurance

Dear customer,
Thermo Haake implements a **Q**uality **M**anagement **S**ystem certified according to EN 29001.
This guarantees the presence of organizational structures which are necessary to ensure that our products are developed, manufactured and managed according to our customers expectations. Internal and external audits are carried out on a regular basis to ensure that our **QMS** system is fully functional.
We also check our products during the manufacturing process to certify that they are produced according to the specifications as well as to monitor correct functioning and to confirm that they are safe. This is why we initiate this monitoring process of important characteristics already during manufacturing and record the results for future reference.

The "Final Test" label on the product is a sign that this unit has fulfilled all requirements at the time of final manufacturing.

Please inform us if, despite our precautionary measures, you should find any product defects. You can thus help us to avoid such faults in future.

3. Your Contacts at Thermo Haake

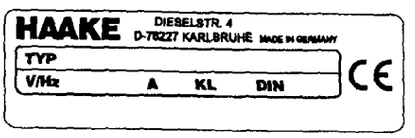
Please get in contact with us or the authorized agent who supplied you with the unit if you have any further questions.

Thermo Haake
Dieselstraße 4
D-76227 Karlsruhe

Tel. +49(0)721 4094-444
Fax +49(0)721 4094-418
E-mailhelpdesk@thermohaake.com

Thermo Haake (USA)
53 W. Century Road
Paramus, NJ 07652

Tel. 201 265 7865
Fax 201 265 1977
infousa@thermohaake.com



The following specifications should be given when product enquiries are made:

- **Unit name** printed on the front of the unit,
- **TYP** as specified on the name plate.
- **Version** of the operating software (see chap. 12.9).

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4. Safety Notes

These notes are intended to draw your attention to risks which only **YOU** can recognize and avoid or overcome. They are intended to enhance your own safety consciousness.

We have set the highest quality standards for ourselves and this unit during development and production. Every unit meets relevant safety regulations. **The correct unit usage and proper handling is however solely your responsibility.**

The intended workplace should correspond to a laboratory or pilot plant environment. The user should have an education level which is at least equivalent to a trained laboratory worker or specialized chemist. The following list should be seen as an example.

! **The device may not be operated if there are any doubts regarding a safe operation due to the outer appearance (e.g. damages).**

! **A safe operation of the instrument cannot be guaranteed if the user does not comply with this instruction manual.**

! **Ensure that this manual is always at hand for every unit operator.**

! **Only use this unit solely for the intended application.**

! **Repairs, alterations or modifications must only be carried out by specialist personnel. Considerable damage can be caused by improper repairs. The Thermo Haake service department is at your disposal for repair work.**

! **Do not operate the unit with wet or oily hands.**

! **Do not expose the unit to spray water or immerse it in water.**

! **Do not clean the unit with solvents (fire risk!) - a wet cloth soaked in household detergent is normally sufficient.**

! **This device is not designed according to the standard EN 60601-1: 1990 (DIN VDE 0750-1 and IEC 601-1) and should not be operated in rooms used for medical purposes and/or in the vicinity of patients.**

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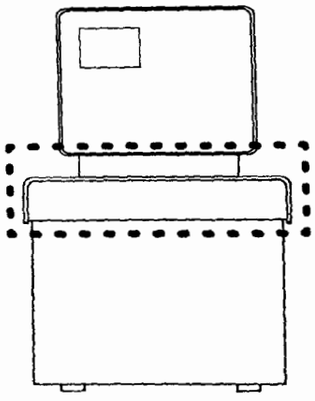
Safety Notes



! **Many units parts can become hot as a result of normal unit functioning - there is a high risk of burns!**
The overall temperature of the marked zone (see fig.) will become higher than 70°C when the bath temperature exceeds approx. 150°C. Please ensure that adequate contact protection is provided.

! **Do not move the unit from the position where it was set up during operation or when it is still hot. There is a high risk of burns!**

! **Only use the heat transfer liquids recommended by Thermo Haake. Please refer to the respective EC Safety Data Sheet.**

! **The temperature controlling i.e. immersing of test tubes, Erlenmeyer flasks or similar objects directly within the circulator constitutes normal circulator practise.**

We do not know which substances are contained within these vessels. Many substances are:

- inflammable, easily ignited or explosive
- hazardous to health
- environmentally unsafe

i.e.: **dangerous**

You alone are responsible for the handling of these substances!

Our advice:

- If in doubt, consult a safety specialist.
- Read the product manufacturer's or supplier's EC Safety Data Sheet according to directive 91/155/EEC.
- Read relevant regulations concerning dangerous materials.
- Observe relevant guidelines for laboratories in your country.

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Safety Notes

The following measures were taken for the protection of the operator:

- Protection Class I according to VDE 0106 T1 (IEC 536) i.e. protection against electric shocks by grounding all parts which carry the risk of electric contact.

☞ The device must only be connected to mains receptacles with a protective ground.

- Protection IP 30 according to EN 60529 for all temperature control units F and N, i. e. regarding the protection against accidently touching live parts and damage by foreign matter, it has been ensured that foreign bodies with a thickness or diameter of more than 2.5 mm cannot penetrate.

- Protection IP 20 according to EN 60529 for all cooling units, i. e. regarding the protection against accidently touching live parts and damage by foreign matter, it has been ensured that foreign bodies with a thickness or diameter of more than 12 mm cannot penetrate.

☞ No special precautions were taken against the penetration of water and dust. The device should therefore not be used in a dusty atmosphere or in the neighborhood of spray water.

☞ Do not insert wires or tools in any of the openings.

! **Complete separation from the mains is required when:**

- **all dangers caused by this device are to be avoided,**
- **cleaning is carried out,**
- **repairs or maintenance work is about to be carried out.**

Complete separation means:

Pull out the mains plug!

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5. Unit Description

All units fulfill the requirements of safety class 2 according to DIN 12879 and are thus suitable for unsupervised continuous operation.

The circulator pump motor is protected against thermal overloading. All temperature sensors are permanently monitored according to break or short circuit. The cooling machine is integrated into the general safety circuit.

The control of the preselected temperature is carried out automatically via the Thermo Haake FuzzyStar® control.

5.1 Safety features

The comprehensive safety system is designed on the principle of the concept of the "single fault" (EN 61010). This assumes that two separate faults do not occur simultaneously. This system therefore offers protection against *one* (single) fault. This one fault will effectively occur automatically ...

- if you do not read this manual,
- if you do not correctly set the excess temperature protection, i.e. the safety reserves have already been used up.

Such faults can include e.g.:

Fault in the temperature control unit:
⇒ Excess temperature ⇒ poss. fire danger

Leakage in the liquid circuit or
Evaporation of heat transfer liquid:
⇒ Low liquid level ⇒ poss. fire danger

Pump blocked or
Heat transfer liquid is too highly viscous:
⇒ Motor overheating ⇒ poss. fire danger

Or also:
Excess temperature protection level not correctly set:
⇒ poss. fire danger

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5.2 Safety class 2 according to DIN 12879

A variably adjustable excess temperature protection and independent low liquid level protection which is preset to the lowest level allow the usage of different heat transfer liquids.

If a safety element is triggered...

- the cause for the fault is displayed,
- the **safety-relevant components** (heating element, motor and compressor) are switched off immediately i.e. the safety circuit transfers the unit to a stable, safe condition,
- the temperature of the heat transfer liquid gradually adjusts to ambient temperature.

5.3 Applications

As open-bath circulator:

For temperature controlling samples within the circulator's own bath.

As heating circulator:

For temperature controlling closed temperature control circuits such reactors, heat exchangers or similar objects.
Temperature controlling of open vessels using the built-in combined pressure and suction pump.

5.4 Temperature ranges

Working temperature range:

The temperature range of the circulator without additional heating or cooling sources.

Operating temperature range:

The temperature range of the circulator which can be reached if additional heating or cooling sources are used.

Tap water can be used as a cooling source. In this case the minimum working temperature possible is approx. 3°C above that of the tap water temperature.

! **High operating temperatures mean the unit surfaces heat up. Protective measures must be taken!**

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Mains cable:

The mains cables used are specially designed for usage with heating elements. They can be allowed to come into contact with parts which are heated up to a temperature of **max. 250°C**.

! **Warning for maintenance personnel: Please ensure that the same sort of cable is used in case of replacement!** (Order no. 082-2409)

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6. Unpacking / Setting Up

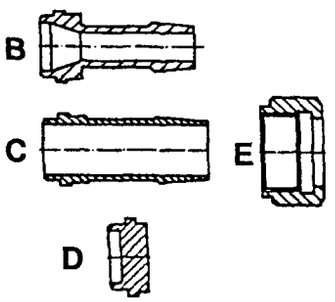
6.1 Transportation damage?

- Notify carrier (forwarding merchant, railroad) etc.
- Compile a damage report.

Before return delivery:

- Inform dealer or manufacturer
  (Small problems can often be dealt with on the spot).

6.2 Contents



2 Coupling Nuts (E),
(already assembled)
2 Plug pieces (D),
(already assembled)
2 Hose fittings
for hoses 8 mm ∅ (B),
2 Hose fittings
for hoses 12 mm ∅ (C)

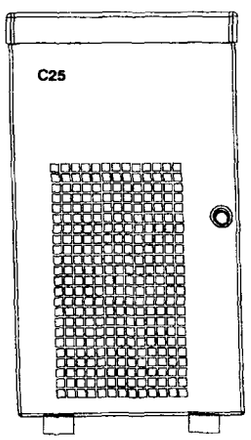
4 Hose clamps,
1 Instruction Manual
1 Warranty Card
(please fill out and return)

6.3 Ambient conditions according to EN 61010

- indoors, max. 2000 meters above sea level,
- ambient temperature 5 ... 40° C,
- relative humidity max. 80%/31°C (→ 50%/40°C)
- excess voltage category II, contamination level 2

6.4 Resting time after transportation (only for refrigerated circulators)

As we can unfortunately not guarantee that our refrigerated circulators are always transported according to our recommendations (i.e. upright), lubrication oil can leak from the compressor into the cooling circuit.
If the refrigerated circulator is started up whilst still in this state, the compressor may be damaged to the lack of oil.
Therefore:



! **Rest the unit for 24 hours after setting up.**

6.5 Ventilation

☞ Keep all ventilation grids (on front and rear) free from obstruction to ensure unhindered air circulation.

! **Blocked ventilation grids lead to increased unit heating which in turn reduces the cooling capacity and thus impairs correct functioning.**

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6.6 Information concerning the CE sign

Thermo Haake circulators and cryostats carry the CE sign which confirms that they are compatible with the EU guideline 89/336/EEC (electromagnetic compatibility). The tests are carried out according to module H (official sheet L380 of the European Community) as our quality assurance system is certified according to DIN / ISO 9001.

The specialist basic standards to be applied are EN 50081-2 for interference emission and EN 50082-2 for interference resistance. The following tests were carried out:

for	according to	
EN 50081	EN 55011 class B	(interference voltage)
	EN 55011 class B	(interference radiation)
EN 50082	EN 61000-4-2	(discharging static electricity)
	ENV 50140	(electromagnetic HF field, amplitude modulated)
	EN 61000-4-4	(quick transient interference variable)
	ENV 50141	(high-frequency asymmetrical, amplitude modulated)
	EN 61000-4-8	(magnetic field with power-engineered frequency)

There are thus no limitations placed on usage. A declaration of conformity can be supplied with the ordered unit on request.

Our strict standards regarding minimum operating quality and the resulting considerable amount of time and money spent on development and testing reflect our commitment to guarantee the high level of quality of our products even under extreme electromagnetic conditions. Practice however also shows that even units which carry the CE sign such as monitors or analytical instruments can be affected if their manufacturers accept an interference (e.g. the flimmering of a monitor) as the minimum operating quality under electromagnetic compatibility conditions. For this reason we recommend you to observe a minimum distance of approx. 1 m from such units.

The CE-sign also certifies the conformity with the EU-directive 72/23/EWG (low voltage regulation). The applied standards are EN61010-1 and EN61010-2-010.

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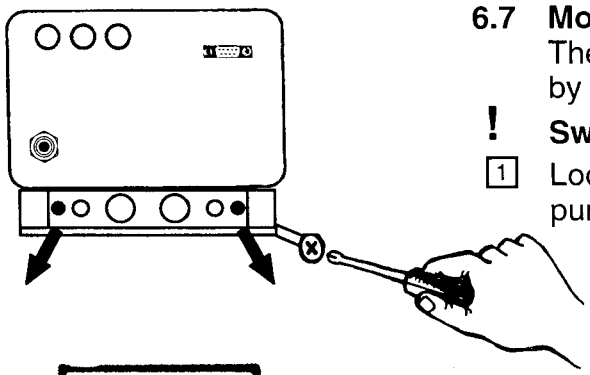
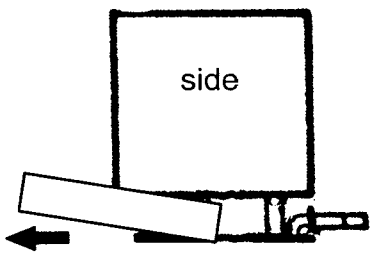


6.7 Mounting onto bath bridges

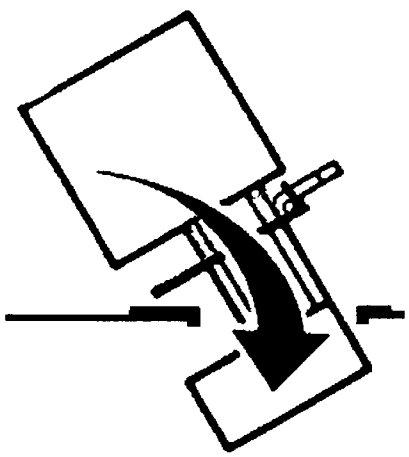
The bath bridges will be delivered unassembled by means of transportation.

! **Switch off the unit and pull out the mains plug.**

1 Loosen the 2 crosshead screws right beside the pump connections.

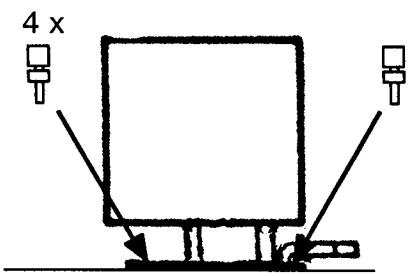


2 Slide the metal jacket to the front (slightly bending may be necessary) and remove it.

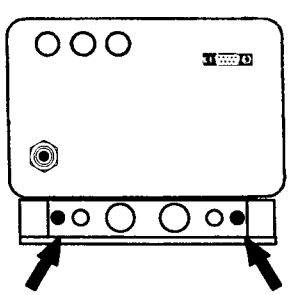


3 Place the gasket around the opening and slide the control head inclined through the opening.

! **Lift the float to avoid any damage.**



4 Attach the unit with 4 screws.
Tighten only by hand.



5 Fix the jacket again with the 2 crosshead screws.

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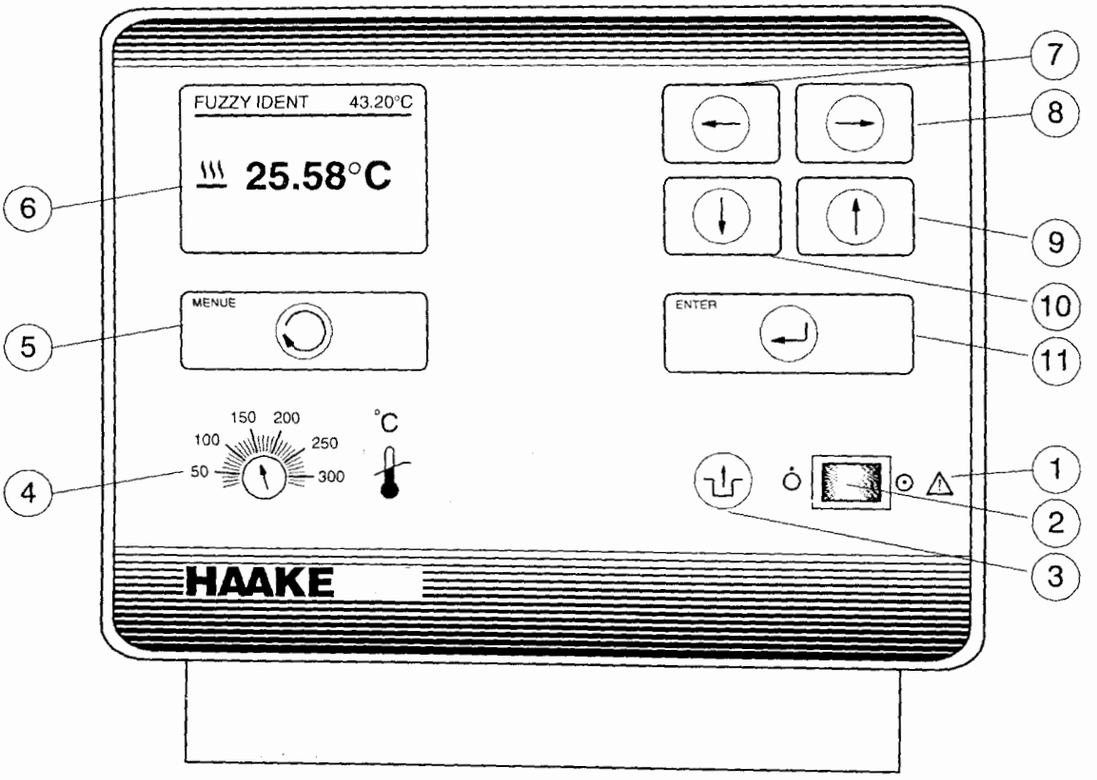
7. Functional Elements

7.1 Front F and N



1 Symbol: Read the instruction manual!
2 Mains switch
3 Reset button
4 Excess temperature setting
5 Menu selection key
6 LCD display
7 Value selection (←) left
8 Value selection (→) right
9 Value alteration (↑) higher
10 Value alteration (↓) lower
11 Enter key

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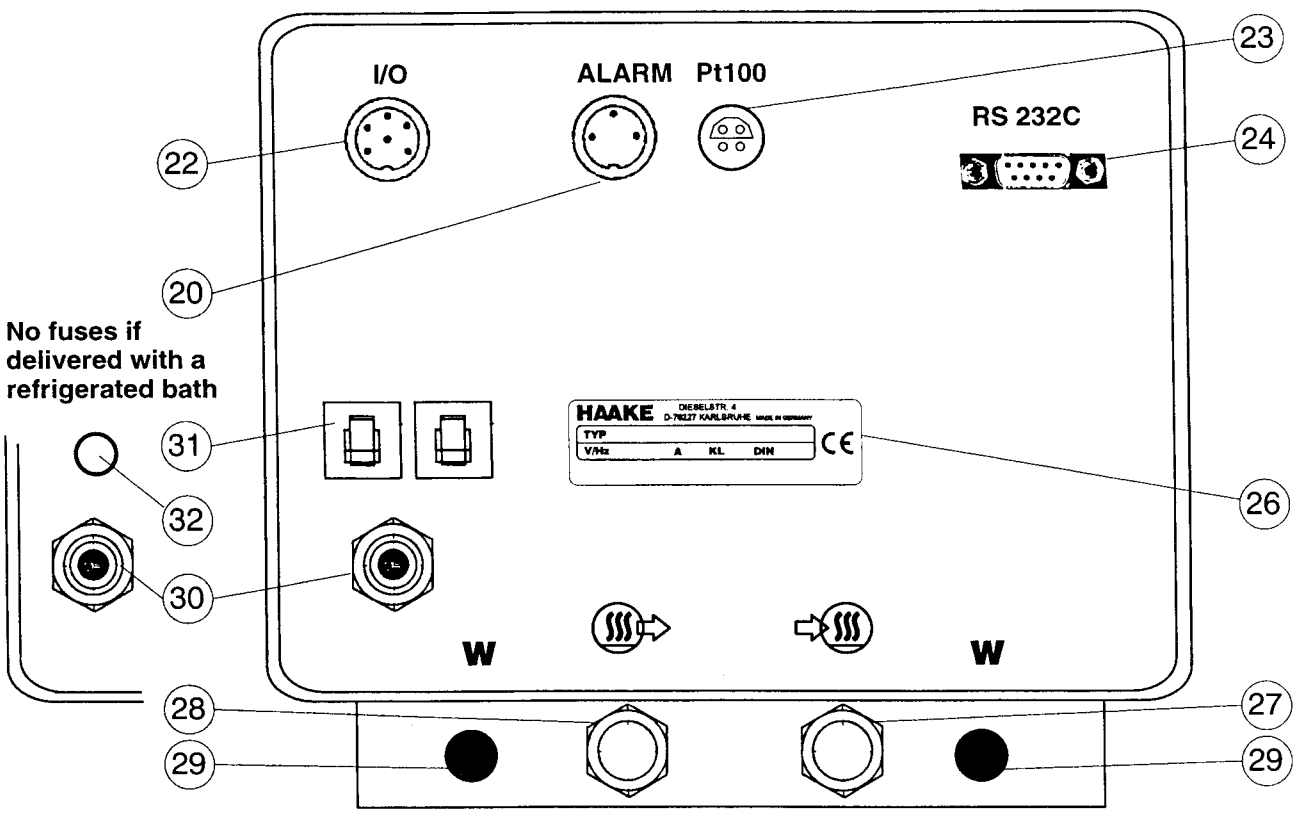
7.2 Rear F and N



20 Socket for external alarm device
22 Socket for analog control signals (**option**)
23 Socket for external Pt100 sensor
24 RS 232C interface
26 Name plate
27 Pump inlet: back flow from the external object
28 Pump outlet: pressure to the external object.
29 Cooling coil fittings for tap water cooling (not for N6: the cooling coil is delivered with the bath vessel); not in conjunction with refrigerated baths
30 Mains cable (or cable to the refrigerated bath)
31 Fuses (not in conjunction with refrigerated baths), if the fuses are triggered, see chap. 11.4
32 Control cable to the refrigerated bath

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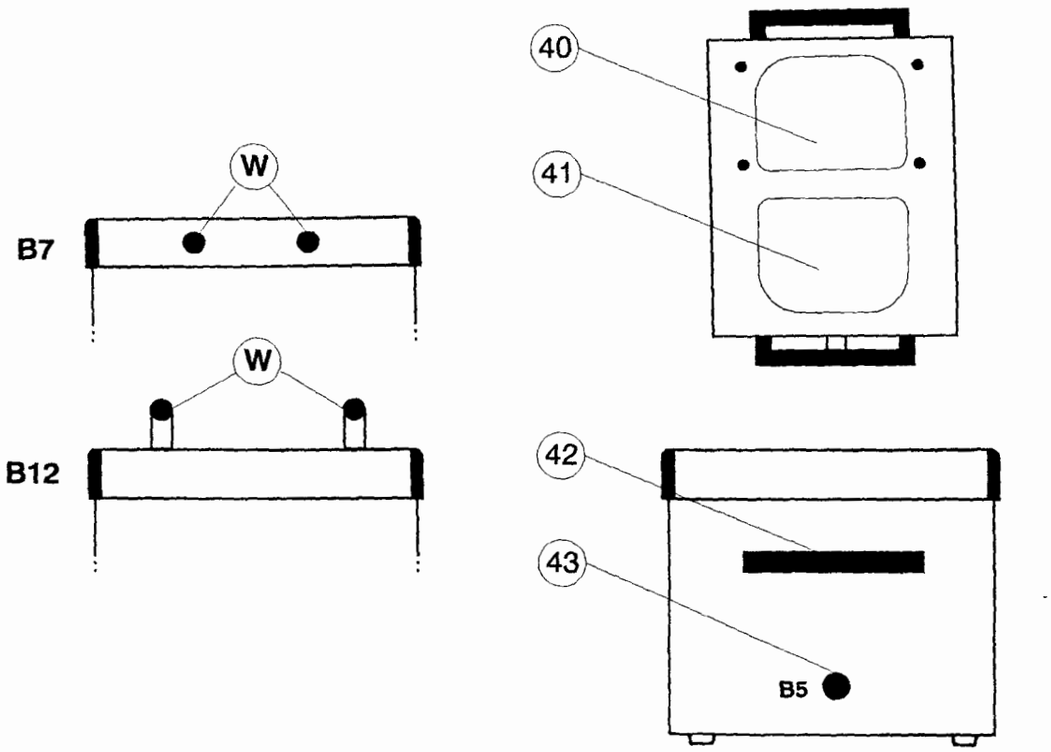
7.3 Bath vessel B5 (example model for B7 and B12)



40 Opening for temperature control module
41 Bath opening with bath covering (standard feature)
42 Handle
43 Drainage nozzle

W **The bath vessels B7 and B12 are delivered with a cooling coil for tab water cooling (for hoses with 8 mm inner ø). The flow direction of the water can be freely selected.**

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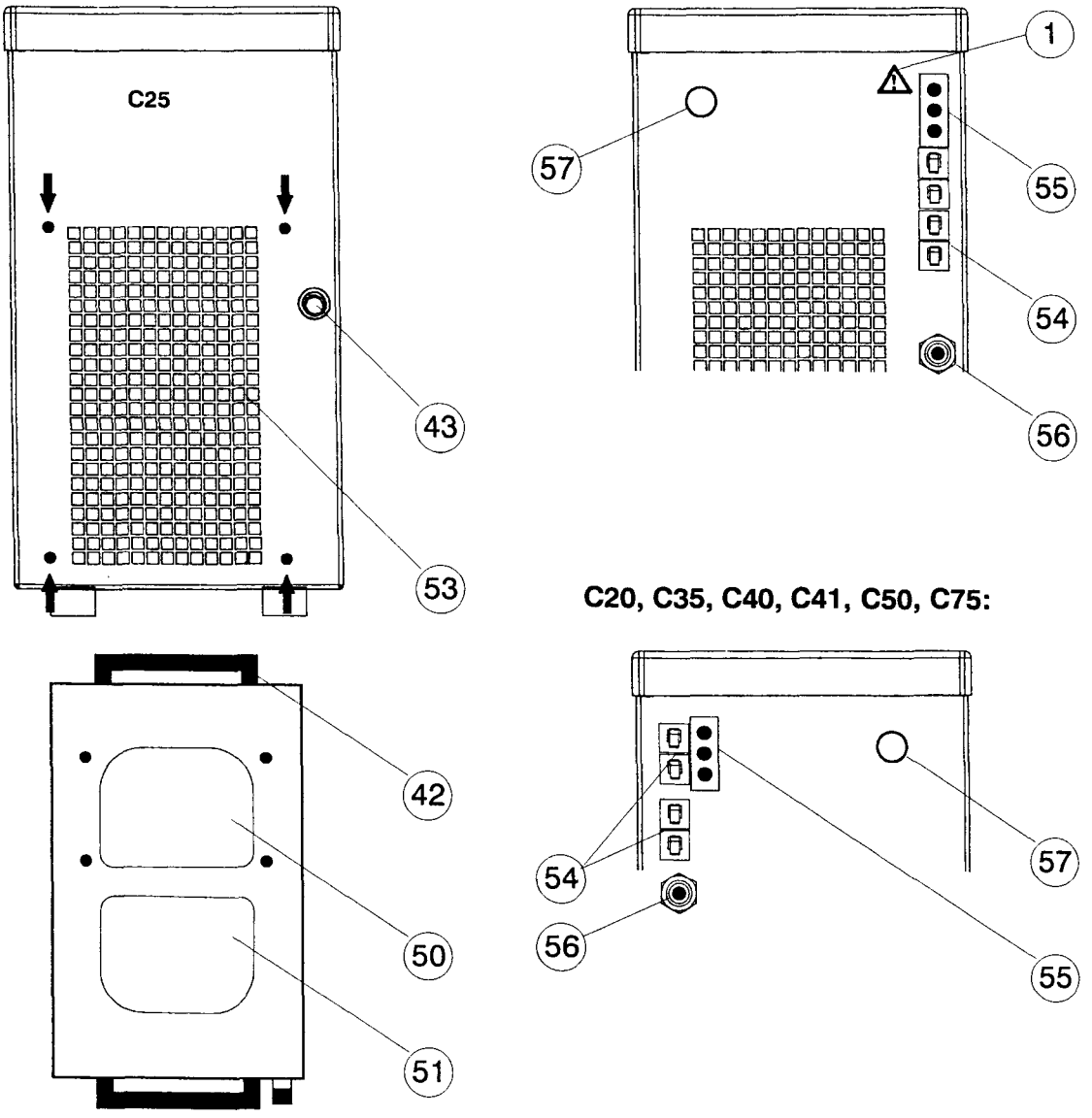
7.4 Refrigerated bath C25 (example model C20, C35, C40, C41, C50 and C75)



1 Symbol: Read the instruction manual!
42 Handle
43 Drainage nozzle
50 Opening for temperature control module
51 Bath opening with bath cover (standard feature)
53 Ventilation grid (removeable, four mounting points: ⬇)
54 Fuses (if the fuses are triggered, see chap. 11.4)
55 Socket for cable **30** from temp. control unit F/N
56 Mains cable
57 Socket for control cable **32** from F/N

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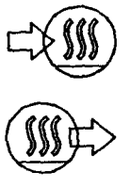
8. Hoses

8.1 Connecting Hoses



Pump nozzle **A**:
return flow from external object

outlet to external object (pressure side)

Hoses are normally used to connect the pump with an external vessel. If objects are to be temperature controlled in the internal bath only, the pump nozzles **A** can be closed with a covering plate **D** attached with a union nut **E** (supplied as standard). However, in order to achieve a better temperature constancy, it is recommended not to close but to connect the two nozzles with a short hose with a min. length of 50 cm.

General recommendations concerning the max. allowable length of hoses cannot be given. It all depends largely on the size, form and material of the external vessel to be temperature controlled. It should be understood that the length of a hose and its diameter combined with the circulating capacity have a large effect on the temperature control effectiveness. Whenever possible, the decision should be made in favor of the wider hose diameter and the vessel to be temperature controlled should be placed as close as possible to the circulator.

! **High operating temperatures will lead to high temperatures on the hose surface, this is even more so at the metal nozzles. In this case: DO NOT TOUCH!**

! **The required hose material is dependent on the heat transfer liquid used.**

! **Hoses must not be folded or bent!**
A wide radius should be used if turns have to be made!

! **Hoses may become brittle after prolonged use or they may get very soft. They should, therefore, be checked regularly and exchanged if necessary!**

! **Secure all hose connections using hose clamps!**

8.2 Selecting Hoses

Thermo Haake circulators will be delivered without any hoses. Due to the unknown application at the time of shipment and the extremely wide temperature range of the circulators it became impossible to deliver hoses as standard accessories. Please select the proper hoses from the following table.

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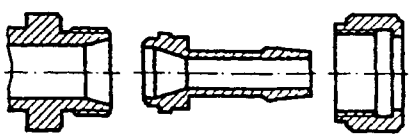
Hoses

Description	Order-No.
Insulated **metal hoses** made from stainless steel with M 16 x 1 unions on both ends. To be used from -90 to +350°C	
50 cm long	**333-0292**
100 cm long	**333-0293**
150 cm long	**333-0294**
Coupling to connect 2 hoses to each other	**001-2560**
PVC hoses to be used only with water	
8 mm i. ∅; per meter	**082-0745**
12 mm i. ∅; per meter	**082-0304**
Viton hoses for a temperature range of -60 to +200°C	
8 mm i. ∅; per meter	**082-1214**
12 mm i. ∅; per meter	**082-1215**
Silicone hoses for a temperature range of -30 to +220°C (not to be used with any silicone oil, for example SIL or Synth 60)	
8 mm i. ∅; per meter	**082-0663**
12 mm i. ∅; per meter	**082-0664**
Perbunan hoses for a temperature range of -40 to +100°C	
8 mm i. ∅; per meter	**082-0172**
12 mm i. ∅; per meter	**082-0173**
Foam rubber insulation for PVC, Viton, Silicone und Perbunan hoses	
for hoses with 8 mm i. ∅; per meter	**806-0373**
for hoses with 12 mm i. ∅; per meter	**806-0374**



8.2.1 Plastic and rubber hoses

If other hoses are used it must be ensured that the hoses selected are fully suitable for the particular application, i.e. that they will not split, crack or become disengaged from their nozzles.

The hoses are connected using the hose fittings **B** supplied for 8 or 12 mm ∅ which are attached to the pump nozzle **A** with the coupling nut **E**.

For the isolation it is highly recommended to use the foam rubber isolation.

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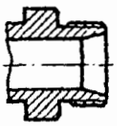
8.2.2 Metal hoses

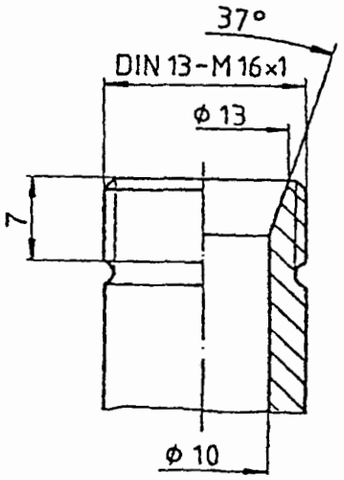


A

Thermo Haake metal hoses (stainless steel insulated) offer a particularly high degree of safety and are suitable for both low and high temperatures.

The metal hoses are attached directly to the nozzle **A**, gaskets are not required.

! The hoses must not be extremely bent or subjected to mechanical strain!



These hoses are available in lengths of 0.5, 1.0 and 1.5 meters from Thermo Haake. Couplings for connecting two hoses are also available if other lengths should be required for a particular application.

The smallest opening inside the metal hoses is 10 mm. The metal hoses are provided with coupling nuts (M16 x 1, DIN 12 879, part 2) at either end. The counter piece for attaching them complies to the left hand sketch.

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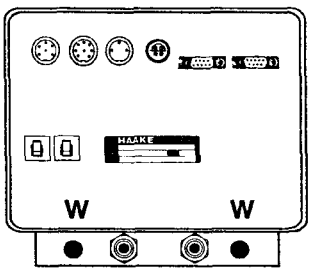
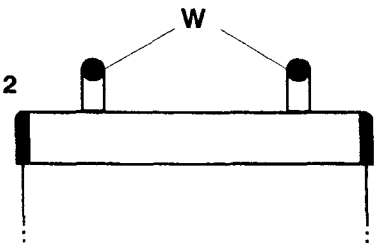
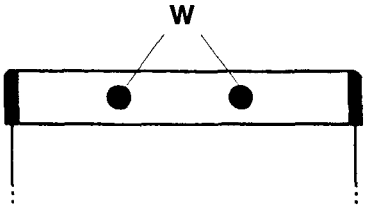
F_-B5



N_-B12



N_-B7



8.3 Tap water cooling

Only for units without own refrigeration unit!

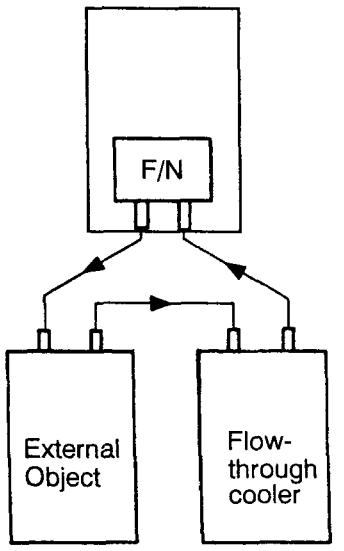
8.3.1 Connection to cooling (tap) water

Using the cooling coil a lowest operating temperature approx. 3°C above the given cooling water temperature can be achieved.

[1] Use hoses with 8 mm internal ∅ and connect to the tab water cooling coil **W.** The direction of the flow can be freely selected. It must be taken care that at the outlet side, the water can run out unhindered.

Pressure fluctuations of the public water net may hamper the temperature constancy. For proper results the water pressure should be stable or measures should be taken to keep it stable.
The min. pressure should not be below 1 bar.

[2] The amount of flow should be set to a min. value. At first the full flow should be used so that the unit can reach its operating temperature. Then, the amount of flow should be reduced using the water cock or a hose clamp. The actual temperature will rise above the set temperature if the water flow is insufficient. If so increase the water flow.



8.4 External Cooling Devices

With the flow-through cooler DK15 from Thermo Haake, the heat transfer liquid can be cooled down and the circulator can be rendered independent of tap water.

The flow-through cooler is hooked up into the return flow line of the external vessel and from there to the circulator (see figure).

The assembly and application are described in the cooler instruction manual in detail.

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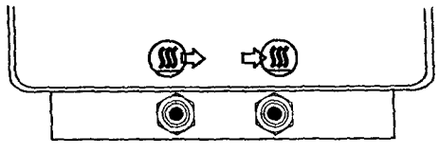
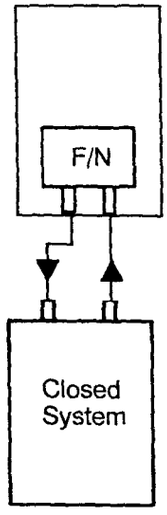
8.5 Pressure pump



8.5.1 Temperature controlling an object in the internal bath

Close pump pressure and return port with the closing pieces and coupling nuts (see chap. 8.1) or, better yet, connect the two nozzles with a short hose.

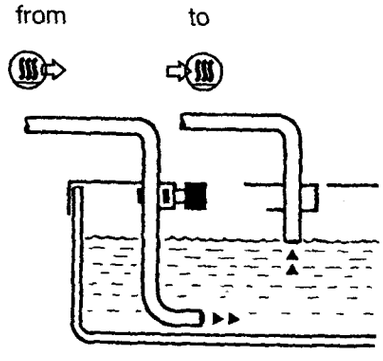


8.5.2 Connection of external closed systems

E.g. instruments with a pressure-tight temperature jacket or coil or a heat exchanger (external system).

Hose connection: From the pressure port to the external system and then back to the return port.

If it cannot be avoided that the external object is situated higher than the circulator, the heat transfer will only not flow back on the condition that the system is completely tight and leak-free. To be on the safe side it may be considered necessary to fit stop cocks to the inlet and outlet hoses.



8.5.3 Connection of external open systems

Hose connection: From the pressure port to the external bath and then back to the suction port.
With a hose support (optional accessory) which is employed for baths with a wall thickness up to 26 mm, both the pressure and suction hose are securely held.
With a clamp in the pressure hose the amount of the circulating liquid is balanced with that of the amount floating back. It is recommended to use a hose with 8 mm interior-∅ as pressure hose and one with 12 mm interior-∅ as suction hose.
The end of the pressure hose in the bath vessel should be placed in a position where an optimum circulation within the bath is achieved.
The liquid level of the external bath can be adjusted with the end of the suction hose.

The external system and the temperature unit have to be arranged so that they have the same liquid level in order to prevent draining by siphoning action. In case the application requires that both systems have to be situated at different levels, the two hose lines have to be closed prior to turning off the temperature unit.

! **When a safety element causes a shut off, the siphoning of one of the vessels cannot be prevented.**

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9. Filling with Bath Liquid

The selection of the proper bath liquid (heat transfer liquid) influences the capacity of a temperature control unit decisively. The technical data with special emphasis on the temperature accuracy was established in accordance with DIN 58 966 (water at 70°C).
The temperature accuracy will decrease the higher viscosity of the heat transfer liquid and the lower its heating capacity is.
It is difficult to arrive at valid statements which can be applied as a general rule as the length of the hoses, the volume and the material of the connected systems have a great influence on this accuracy.

The heating up and the cooling down time of a system to be temperature controlled can be influenced by the bath liquid too. Oil, for instance, cuts this time in half when compared to water.

9.1 Recommended bath liquids

5 to 95°C

Distilled Water

- Normal tap water leads to calcareous deposits necessitating frequent unit decalcification.

! **Calcium tends to deposit itself on the heating element. The heating capacity is reduced and service life shortened!**

- Water, of course, can be employed up to 95°C, however above 80°C water vaporization reaches a level which necessitates the liquid to be constantly replenished.

-10 to 80°C

Water with Antifreeze

In applications below 5°C the water has to be mixed with an antifreeze. In doing so, the amount of antifreeze added should cover a temperature range 10°C lower than the operating temperature of the particular application. This will prevent the water from gelling (freezing) in the area of the evaporating coil the surface area of which is much colder than the working temperature. An excess of antifreeze deteriorates the temperature accuracy due to its high viscosity.

-40 to 145°C

SIL180

...this heat transfer liquid is suitable for covering nearly the entire range with just one liquid especially when used with the cooling units C25, C40 and C41.
Unfortunately *SIL180* has a creeping tendency necessitating the occasional cleaning of the bath cover.

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-10 to -75°C *Methanol or Ethanol*

Those liquids are usually only used at lower temperatures. Their flash point is at about 10°C. Therefore, they cannot be used in accordance with the standards EN 61010 or DIN 12879.

other temperatures

Thermo Haake offers a range of heat transfer liquids for these temperature control applications.

Synth ... : Synthetic thermal liquid with a medium life span (some months) and little smell annoyance.

SIL ... : Silicone oil with a very long life span (> 1 year) and negligible smell.

Please use the table on the next page or get in contact with us if you should have any questions. We are glad to advise you and can help you to choose a heat transfer liquid suitable for your application.

Thermo Haake heat transfer liquids are supplied with an EC Safety Data Sheet.

! Important ! **Thermo Haake takes no responsibility for damages caused by the selection of an unsuitable bath liquid. Unsuitable bath liquids are liquids which e.g.**

- are very highly viscous (much higher than 30 mPa·s at the respective working temperature)
- have corrosive characteristics or
- tend to cracking

! Important ! **It is absolutely mandatory that the overtemperature cut-off point is set lower than the fire point for the heat transfer liquid selected (see chapter 14.).**

! Important ! **The highest working temperature as defined by the EN 61010 (IEC 1010) must be limited to 25°C below the fire point of the bath liquid.**

! Important ! **Please ensure when selecting other heat transfer liquid than ours that no toxic gases can be generated and bear in mind that inflammable gases can build up over the liquid during usage.**

! Important ! **At bath temperatures of over 200°C the usage of a heat take-off is recommended.**

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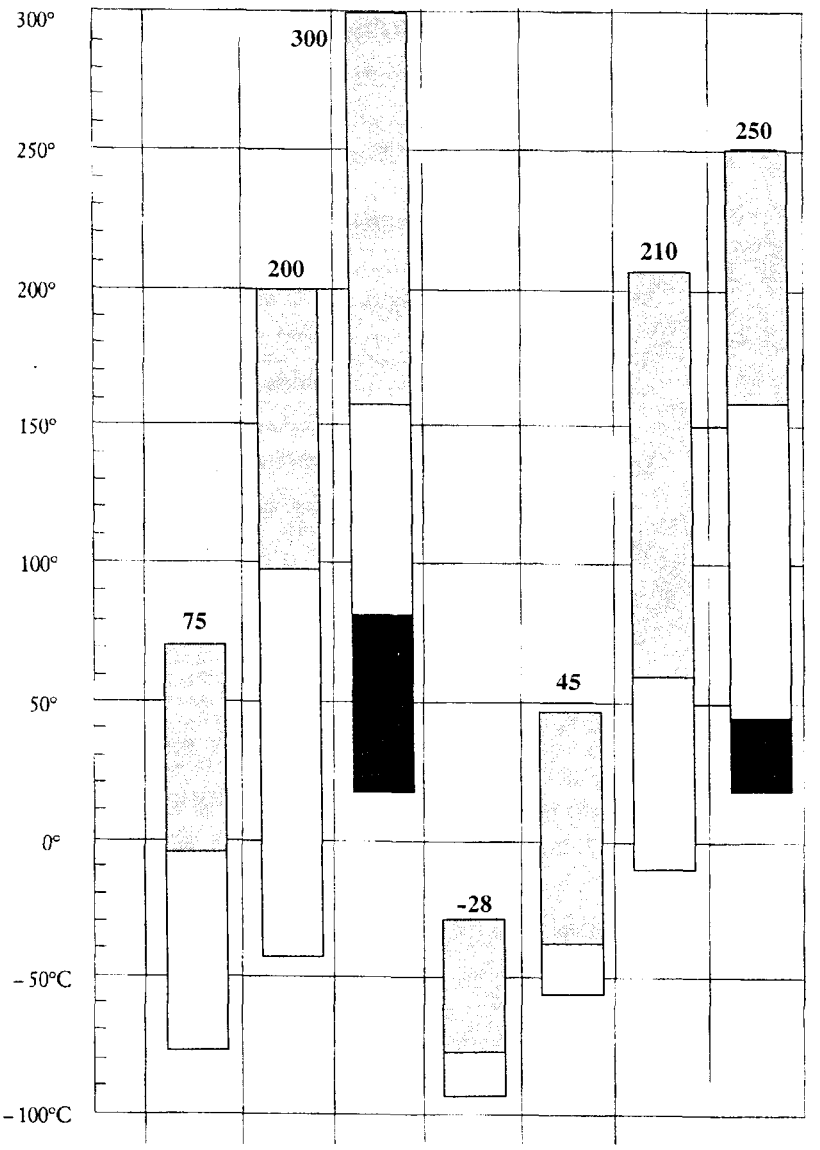
Filling

Range of Application		Sil 100	Sil 180	Sil 300	Synth 20 *)	Synth 60	Synth 200	Synth 260
Fire point	°C	>100	>225	>325	no sp.	70	>235	275
Flash point	°C	57	170	300	-3	59	227	260
Viscosity	at 20°C [mPas]	3	11	200	<1	2	100	140
Density	at 20°C [kg/dm^3]	0,89	0,93	1,08	0,77	0,76	0,86	1,03
Specific heat capacity	[kJ/kg*K]	1,67	1,51	1,56	no sp.	2,10	1,96	2,00

Temperature range



Colour		trans-parent, colour-less	trans-parent, colour-less	trans-parent, colour-less	trans-parent, colour-less	trans-parent, colour-less	trans-parent, light-brown	trans-parent, yellow
Reacts with		Silicone	Silicone	Silicone	Light-metals Zinc	Rubber Silicone	Copper Light-metals Bronze	Copper Light-metals Bronze
Order-No.	10 l Container	999-0202	999-0204	999-0206	999-0208	999-0210	999-0226	999-0214
	5 l Container	999-0201	999-0203	999-0205	999-0207	999-0209	999-0225	999-0213

*) Cannot be exported, use methylcyclohexan as bath liquid.

EC-Safety Data Sheets will be delivered together with each container of liquid.

no sp. = no specifications

Heating-up range

operating temperature range

Working temperature range

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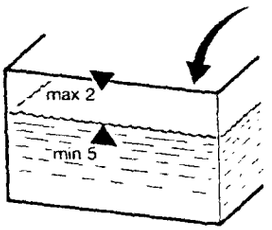


9.2 Filling with heat transfer liquid

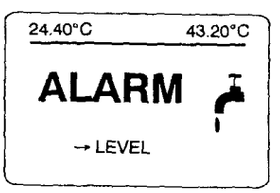
Filling level of the interior bath:
max. up to 2.0 cm below the cover plate,
min. up to 5.0 cm below the cover plate.

When working with water or water with antifreeze: or with oil below ambient temperature:
the filling level should be 2 cm below the deck plate.

When working with oil above 80°C:
Keep level somewhat lower. Oil expands when being heated. Rule of thumb: 10% volume increase per 100°C heat increase.

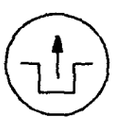
External systems included within the circulating circuit have to be filled with the same heat transfer liquid in order to avoid too much liquid being drawn from the internal bath.

☞ The bath level should be checked when the preset temperature has been reached!



Quite often closed external systems cannot be prefilled as suggested. In this case the internal bath of the unit has to be filled to the max. level. After starting the unit, the pump will feed the necessary liquid to the external system. Should the demand be higher than the volume difference between high and low, the low liquid level sensor will be activated and the pump switched off.

In this case:



1. Replenish the liquid.
2. Reset the unit:
   Depress the reset button.
   ⇒ The unit starts up again
3. Repeat this action if necessary.

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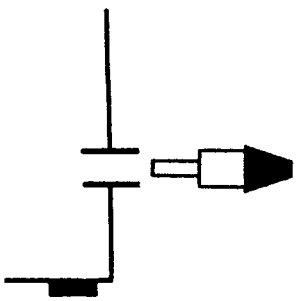


10. Draining

The temperature control unit is drained at the nozzle.

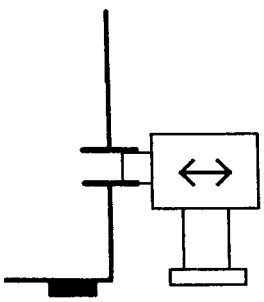
1 Place a suitable vessel underneath nozzle.

☞ Bear in mind that the liquid will run out in a slight arc.

2 Turn plug slowly until it becomes disengaged from the thread. A pin will prevent the liquid from running out right away.

3 Pull out plug (pin) in one quick motion. The liquid will start to run out.

4 Possible residues can be drained by tilting the circulator slightly.



Option:

Use the liquid drain (order no. 333-0499). This push and pull version makes emptying easier.
For assembly it is necessary to use a fork wrench of 17 mm.
Double safety against unintended opening is avoided if the nozzle will be closed by the closing screw after use.

! Hot heat transfer liquid should not be drained! When certain conditions make draining necessary, please act safety conscious: Wear protective clothing and protective gloves!

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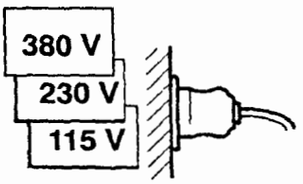
11. Connecting Up

11.1 Connecting to the mains



Only attach this unit to mains sockets with a grounded earth. Compare the local mains voltage with the specifications written on the name plate. Voltage deviations of +/- 10% are permissible. The socket must be rated as suitable for the total power consumption of the unit.

Make sure that the temperature controller F8 or N8 are safely connected to the refrigerated units with their two cables **30** and **32**.

11.2 Checking the liquid circuit

Before switching on, check again to make sure that the pressure and suction ports are either connected with each other or blocked with covering plugs or alternatively if an external object is to be temperature controlled, that the hoses are connected correctly and secured (see chapter 8.).

11.3 Changing the mains plug (e.g. for Great Britain)

! This should only be carried out by qualified specialist personnel!

The mains cable wires have the following colors:

Brown	=	**Live**
Blue	=	**Neutral**
Green/Yellow	=	**Earth**

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11.4 Fuses on the unit

All units are equipped with automatic thermally-triggered fuses.

If the fuse has triggered...

- the fuse does not have to be exchanged - resetting suffices;
- a white marking is visible;
- a certain cooling down time should be allowed (approx. 5 min) before the (dip) switch can be pressed again.

! **Do not use tools; do not use force. Both destroy the fuse.**

! **If the fuse should be triggered again after resetting, the unit probably has a defect. In this case the unit should be sent in for servicing.**

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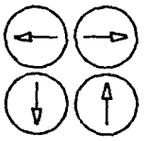
12. Configuration

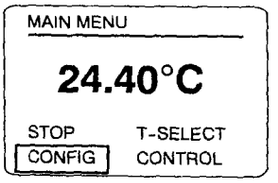
Especially when putting into operation for the first time it is necessary to adjust some parameters.

The menu key is used to open the main menu or to leave other menus after input.

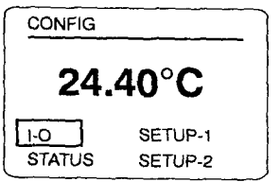
The enter key is used to confirm a selection.



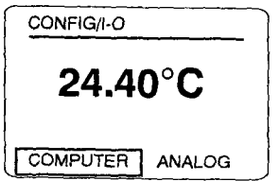
Use the arrow keys to select the desired menu point.



Select CONFIG in the main menu.

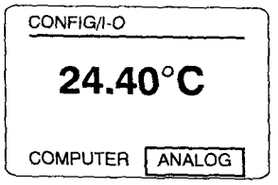


Under CONFIG there are several submenus.
In the following displays the selected submenu is shown in the first line.



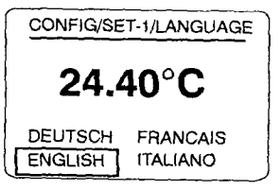
12.1 Interface RS 232C

Select I/O and then COMPUTER (for more information see chapter 18.).



12.2 Analog interface (option!)

Select I/O and then ANALOG. This menu point only will be active in combination with a built-in I/O socket.
This option will be described separately.



12.3 Language

Select SETUP-1 and then LANGUAGE.

Confirm the selected language with ENTER.

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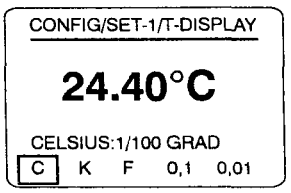


12.4 Temperature display

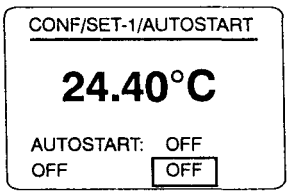
Select SETUP-1 and then T-DISPLAY.

Confirm the standard (°C, °F or K) and the resolution (0.1 or 0.01) using the ENTER key.

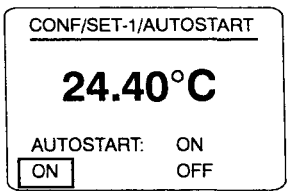
12.5 Autostart

Select SETUP-1 and then AUTOSTART.

With the enter key confirm AUTOSTART ON or OFF.

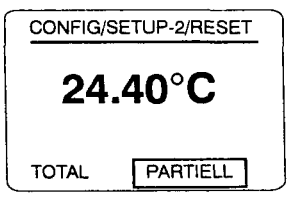


AUTOSTART: OFF
The temperature control module switches itself off in case of a power failure. Switching on again is only possible with the START command in the main menue. This is due to safety reasons. The unit reacts in the same way if it is switched on via a mains switch in the laboratory.



AUTOSTART: ON
The temperature control module switches on automatically after a power failure and will be operating with the saved values.

! Please consider any possible resulting risks!



12.6 Reset

Select SETUP-2 and then RESET.

TOTAL resets to the default parameter settings !
PARTIELL only re-initializes the FuzzyStar® control.

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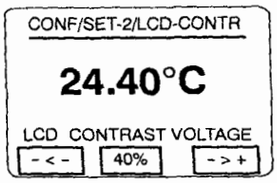
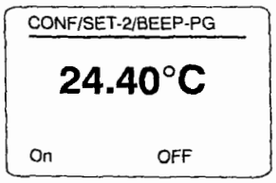


12.7 Display contrast adjustment

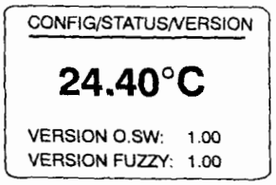
For contrast adjustment of the display select SETUP-2 and then LCD-CONTR.

Change the contrast using the (←)/(→) keys. The value will be shown in %, The contrast changes with a short delay.



12.8 Acoustic Signal

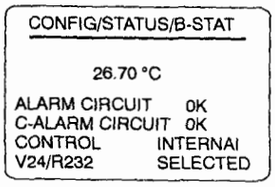
Select SETUP 2 and then BEEP-PG.
Whenever the BEEP has been switched on an acoustical message appears after the program run. This will last for one minute.



12.9 Version numbers

For servicing or in case of product enquiries the version numbers of the software or the FuzzyStar® control should be given.

Select STATUS and then VERSION. The version numbers will be shown.



12.10 Operation status

For information about the operating status (alarm circuit of the instrument or cooling device (C-AL...), internal or external control and interface) please select STATUS and then B-STATUS.

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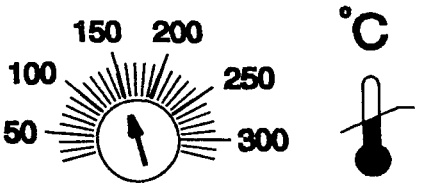


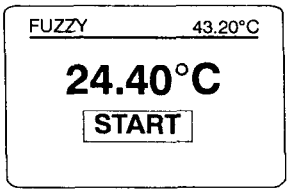
13. Operating

13.1 Switching on

1 Set the excess temperature limiter well above the desired set temperature.

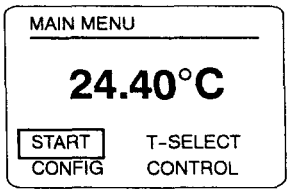
2 Switch on the unit via the mains switch (2) at the temperature control unit F/N.

⇒ Two temperatures are shown on the main display:
- set temperature (e.g. 43.20°C) in the top right corner (the temperature momentarily to be reached)
- actual temperature (e.g. 24.40°C) in the center.



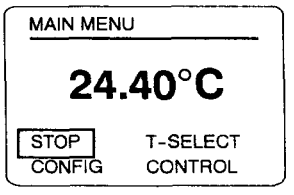
This results in the following display if 'AUTOSTART: OFF'

⇒ START flashes in the display

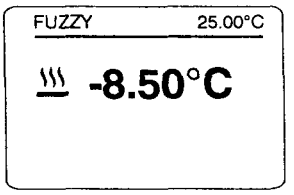


3 Select the main menu, alter the configuration, control or temperature setting if desired and initiate START via the ENTER key.

The main menu display then shows STOP. The unit can be rendered inoperable at any time by executing STOP via pressing the ENTER key.

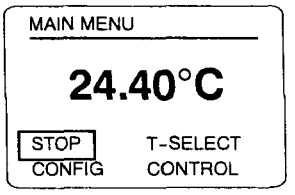


! C35:
In case of restarting the unit within approx. 5 minutes after it had been stopped the cooling compressor will be switch on delayed for safety reasons.



! All refrigerated circulators:
To increase the life of the refrigerated unit, it is recommended to wait five minutes after switching off before the unit is restarted.

This results in the following display if 'AUTOSTART: ON'



The unit begins to work immediately. The pump, heating, cooling and control functions are active straight away.

The unit can be rendered inoperable by selecting STOP in the main menu and then pressing the ENTER key.

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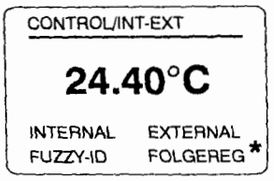
13.2 Working with internal or external control sensors

The internal control sensor is an immovable fixture. Any commercially available Pt100 sensor equipped with 4-wire technology can be used as the external sensor. For connecting up see chapter 17.

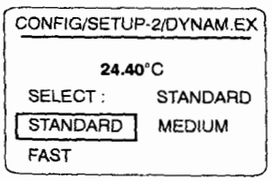


The circulator must be switched off and on again after inserting an external sensor. The function EXTERNAL is otherwise not selectable. The unit switches automatically back to the function INTERNAL.

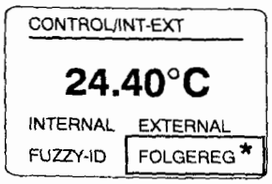
[1] Select CONTROL, then INT-EXT and choose if you want to work in the INTERNAL or EXTERNAL mode (or in the "FOLGEREG" mode).

Three different control speeds are selectable in the EXTERNAL mode.

[2] Select CONFIG → SETUP-2 → DYNAM.EX



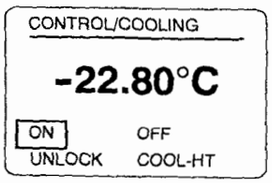
The unit is preset to the control speed STANDARD. Overswinging is thus avoided for the most part. The time until the desired temperature has been reached can however be quite long. If you would like to shorten this, select MEDIUM or FAST. When using the setting FAST you should reckon with quicker control times. The setting MEDIUM results in moderate overswinging and medium control speeds. The level of overswinging is dependent on a number of factors such as the volume of the external system. the heat transfer liquid used, hose length, the working temperature and many others. No general statements can thus be made at this point.



"FOLGEREG" mode: temperature control is depending on the measured temperature at the external sensor.
* To activate this menu the menu key has to be pressed while switching on the unit until the first display message appears.

13.3 Working with or without cooling

You should decide if the usage of the cooling aggregate (if fitted) is necessary depending on the desired set temperature.



[1] Select CONTROL and then COOLING.
Switch the cooling aggregate ON or OFF.
The crossed-out star is on when the cooling unit is off.

When chosing COOLING ON the complete cooling capacity is available for the cooling unit of the C25. All the other units are cooling controlled.
When switching shortly between ON and OFF the cooling unit of the C35 will start only with a delay of 3 minutes. A timer in the display will show the timing.

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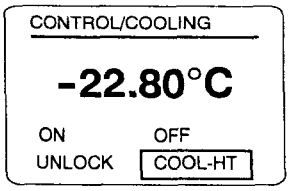
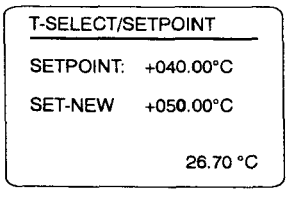
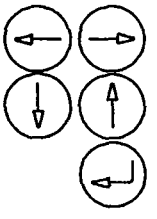


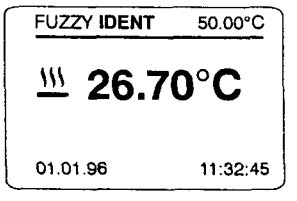
If the set temperature value is higher than 100°C the cooling unit will not be switched on. Nevertheless, for special applications, e. g. an expected exothermal reaction, it could be suitable to let the cooling unit run (only partial cooling capacity of 30% of the full capacity).

2 Select CONTROL, then COOLING and then COOL-HT. Switch to ON if the cooling unit should run (default setting is OFF).

13.4 Setting the desired set temperature







The settings apply to the internal or external control sensors according to the selected mode INT-EXT (see chapter 13.2).

1 Select T-SELECT and then SETPOINT. The currently valid value is displayed in the SETPOINT line. The SET-NEW line indicates the alteration.

2 Use the arrow keys to select the digit to alter.

3 Alter the value between 0 and 9.

4 Confirm the changes with the ENTER key.

⇒ The new value is accepted in the SETPOINT line.

⇒ **IDENT** flashes for a short time after the desired temperature has been set: The FuzzyStar-controller is determining the right parameter. It can happen that heating or cooling is interrupted during this process and the displayed temperature changes. This is because the control unit requires some time to determine the parameters.

☞ To switch off the identification please see chapter 15.9.

The input is blocked if a temperature setting over I/O port already exists or the programmer is active. The message "I/O started" or "PG started" will be displayed.

13.5 Setting the RTA system correction value

The display shows the actual temperature at the internal or external control sensor with the selected resolution.

This temperature does not correspond directly to the temperature in the circulator's bath and even less to the temperature in the external connected system.

The temperature difference is determined by measuring the actual current temperature using a suitable measuring device (calibrated or gauged thermometer).

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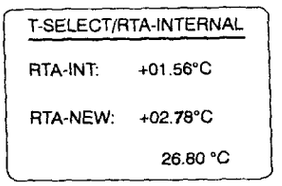
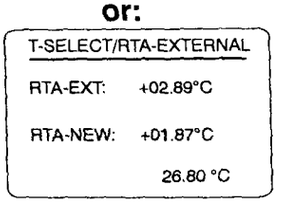


or:



It is entered into the circulator as the correction factor RTA and remains stored there.

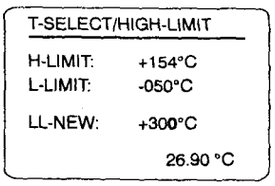
The correction factor only refers to this one application. A new correction value is required for any new temperature or altered test setup.

1 Select T-SELECT and then RTA. Alter the display in same way as described in chapter 13.4.

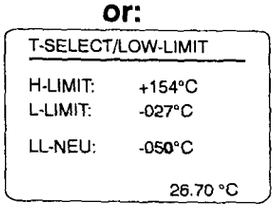
! Only if a value input has been made it can be switched over to negative (-) values.

13.6 Setting temperature limit values

The setting range of the operating temperature of the circulator can be limited if the application or the flash point of the selected heat transfer liquid requires this.



or:

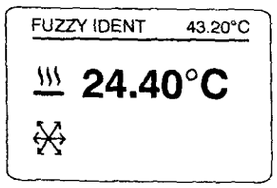


! This is not a safety element but merely an aid to help avoid user faults when operating the unit. The excess temperature protection must be set separately.

When in the external control mode (for EXTERNAL setting see chapter 13.2), the limits set restrict the temperature in the circulator's own bath in order to guarantee a higher degree of safety against unintentional heating up or cooling down.

1 Select T-SELECT and then LIMIT. Alter the display in same way as described in chapter 13.4.
First HIGH and then LOW-LIMIT.
If the HIGH-LIMIT value is lower than the set temperature value, the set value is decreased according to the HIGH-LIMIT value.

13.7 Controlling heating and cooling



Heating and cooling are cycled. ♨ is illuminated when heating is activated. ✳ or ✳ is illuminated when cooling is activated. Flashing of the star means a cooling control between 30 and 100%.

or ✳ lights up if cooling is active with full cooling capacity,

or ✳ lights up if cooling is active with partial cooling capacity,

or ✳ lights up if the cooling unit is off.

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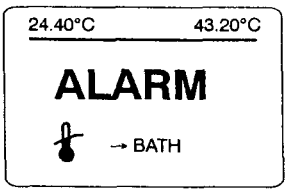
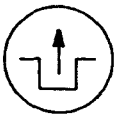


14. Excess Temperature Protection

If this safety device is triggered:

- The alarm indication on the display flashes
- An acoustic signal is sounded
- all voltage conducting unit components (the heating element, the pump motor and if available, the compressor) are switched off immediately i.e. the safety circuit transfers the unit to a stable, safe condition.

☞ **The fault cause must be identified and remedied.**

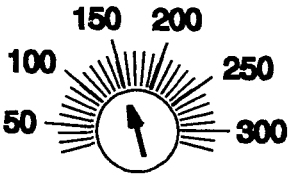


After the fault has been eliminated the unit can be started again by pressing the reset key.

14.1 Excess temperature protection dial

It offers protection against dangers caused by an uncontrolled heating up of the heat transfer liquid above the desired set temperature.

The cut-off temperature is adjusted with the excess temperature setting dial.



☞ **Proper protection can only be guaranteed if the cut-off point has been correctly set.**

There are two main aims for correct setting:

- **Safety (primary importance):**
  Protection against ignition of the heat transfer liquid. The cut-off point must be set at least 25°C **below** the fire point of the bath liquid used.
- **Protection of the object to be temperature controlled (secondary importance):**
  Additional protection, e.g. of a biological sample. The cut-off point should be set as close as possible to the desired temperature value.

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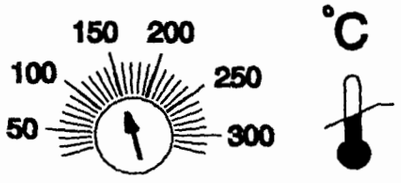
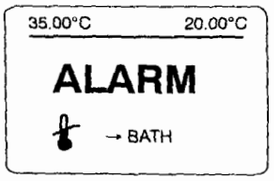
Excess Temperature Protection



14.1.1 Setting the excess temperature

The cut-off point is set with the excess temperature dial with a rough scale of temperature values arranged around it. This scale, of course, can only serve as an approximate setting means for this cut-off point. However, the cut-off point can be determined to act exactly if the following procedure is adhered to:

If for instance a bath liquid has a fire point of 60°C the unit should cut off after reaching 35°C at the latest:



1. First set the desired set value to exactly 35°C.
2. After the circulator has reached this temperature, turn the excess temperature dial backwards very slowly (to the left) until the unit cuts off (acoustic signal, alarm is flashing).
3. Then set the set temperature to the actual temperature (< 35°C).
4. Reset the unit via the reset key after the heat transfer liquid has cooled down somewhat.

   ⇒ The unit can now be used for temperatures below 35°C. As soon as 35°C is reached, it is securely switched off.

14.1.2 Testing the cut-off point

Set the set temperature to a higher value than 35°C, set the unit to heat up and watch the digital display. The value indicated when the alarm goes on is the real cut-off temperature.

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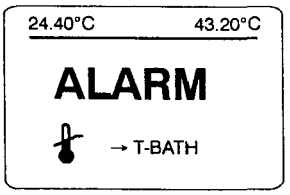
15. Fault Displays

An acoustic signal is sounded and "ALARM" is shown on the display. The heating element, the pump and if available, the compressor are completely switched off.

15.1 Excess temperature



The excess temperature protection can be triggered if:

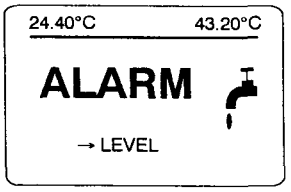
- Excess temperature has been set too closely to the desired working temperature

  ⇒ increase value slightly according to specifications made in chapter 14.1.1.

- the control function is defective

  ⇒ Return unit for servicing.

15.2 Low liquid level cut-off



The low liquid level protection can be triggered if:

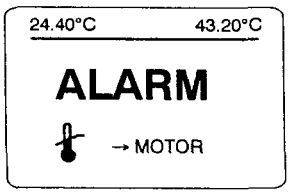
- there is not enough liquid in the bath

  ⇒ check for leaks, top up if necessary,

  ⇒ fluid has evaporated, replenish liquid.

- the prewarning has been ignored.

15.3 Pump or motor overloading



The motor or pump is blocked:

⇒ It can take 10 min or longer, until the motor temperature has sunk far enough so that the unit can be switched on again by pressing the reset key. If the circulator switches off again after a short time, return the unit for servicing!

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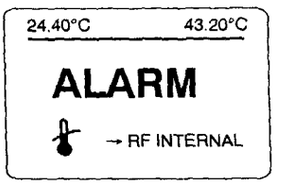
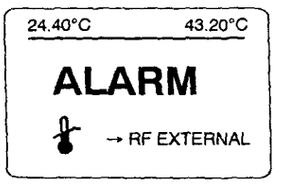


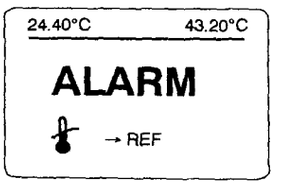


15.4 Sensor breakage or short circuit

This fault can correspond to the internal sensor (RF internal) or to an external sensor (RF external) connected to the socket on the rear.

⇒ Improve shielding of the sensor connector cable. (see chapter 17.5)

⇒ The sensor must be tested and possibly exchanged by qualified service personnel.

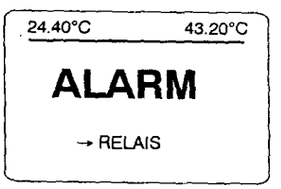


The message "REF" means that the reference resistor for the measuring value evaluation is out of order.

⇒ Improve shielding of the sensor connector cable. (see chapter 17.5)

⇒ return unit for servicing.

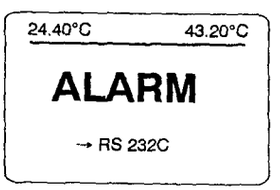
15.5 Undefined fault



This can be caused by fault which only occurs for a short period of time, i.e. with a fluctuating bath level when the filling level is very close to minimum.

Before returning the unit, top up with heat transfer liquid. This fault can often be remedied in this way!

In all other cases this unit must be checked by qualified service personnel.



15.6 External fault RS232C

The circulator has been switched to fault status via the interface.

⇒ Check the external system.

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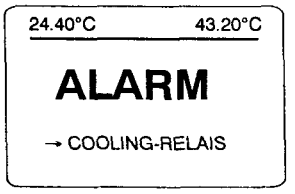
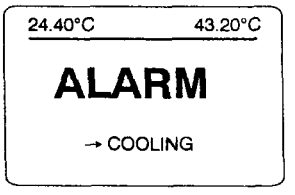
15.7 Error in connection with cooling units

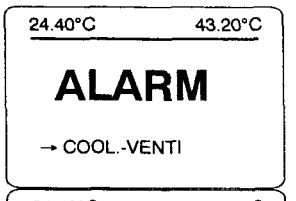


The alarm message "COOLING-RELAIS" appears as soon as an error occurs in the cooling unit. If the error can be further specified one of the following messages appears soon after the first error message has appeared. If the error cannot be specified, the message "COOLING-RELAIS" keeps visible in the display.



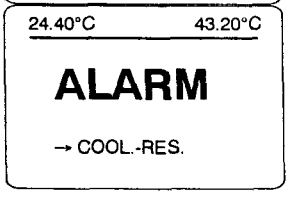
If the compressor of the cooling unit is overloaded the circulator will be switched to fault status: "COOLING". Allow the unit to cool down for a few minutes and then try to start up again. If the fault occurs again ...

⇒ return unit for servicing.



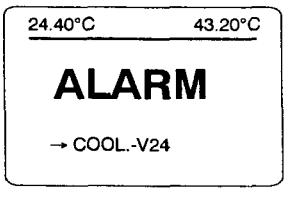
The alarm message "COOL.-VENTI" appears in case of an overloading of the motor caused by the compressor 1.
The message "COOL.-RES." appears in case of an motor overload caused by the compressor 2.

⇒ in both cases return unit for servicing.



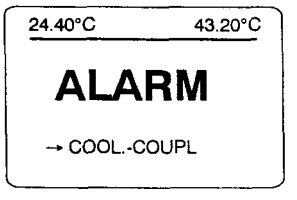
If " COOL.-V24" appears there is a communation error between the F/N head and the cooling device.
Restart the unit. If this error appears again:

⇒ return unit for servicing.



The message "COOL.-COUPL" informs about disconnection of the F/N head and the cooling device.
Check the connection and fuses and restart the unit.
If the fault occurs again...

⇒ return unit for servicing.

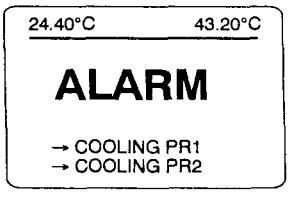


The message "COOLING PR1 (PR2)" indicates a too high pressure within the refrigerant circuit.
PR1 = 1st step (PR2 = 2nd step)

Possible reasons for appearance of message "PR1":

- ambient temperature too high → eliminate sources of heat; avoid insolation.
- water supply is interrupted (for water-cooled versions only) or the water is too hot → make sure that the circulation is not interrupted.
- Fins of the liquefier are dirty → cleaning of fins according to chapter 20.1.
- ventilation out of order (noise) → return to service

or:



When the message "PR2" appears restart the unit. In case of a second error message inform the service.

⇒ Return unit to service.

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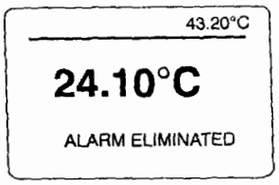
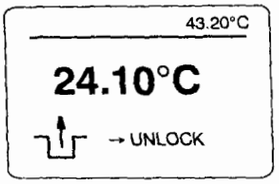


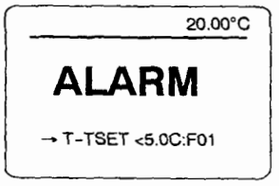


15.8 Fault eliminated?

"ALARM ELIMINATED" and "UNLOCK" appear alternately on the display.

⇒ The reset key must be pressed in order to start up the unit again.

Message PR1 (and PR2):
Depending on the unit type it can last up to one hour until the unit is ready to restart.



15.9 Fault displays of the Fuzzy control

Fault 1: Fault during identification

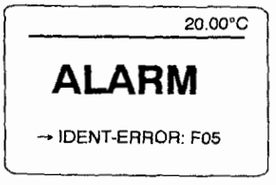
If at the beginning of the identification the set temperature is changed by the user so that the temperature difference between the actual temperature and the new set temperature is smaller then 5°C, fault 1 occurs.

⇒ Switch off and on unit.

or

⇒ RESET actuate in the SETUP-2 menu.

☞ **If you should set the desired temperature via the I/O card, please see chapter 23.7.**



Fault 4 and Fault 5: Fault during identification

During the identification, to determine ideal control parameters the Fuzzy control repeatedly measures temperature gradients, delay times etc.

The identification result, which is made up of a great number of measurements, is continually checked for plausibility. In case of discrepancy en error message appears.

In order to remove the fault two different modes have to be distinguished:

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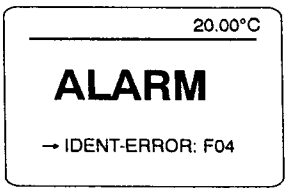
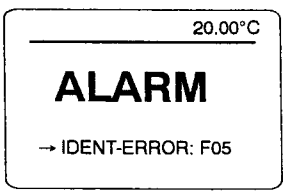
Fault Displays





Operation with programmer:

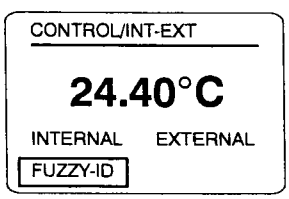
If **fault 4 or 5** occurs while a program is running:

⇒ return unit for servicing.

Operation without programmer:

If **fault 4** occurs, the identification is considerably disturbed by external heat flow.

⇒ Arrange for constant temperature conditions and try another identification run.



⇒ As this fault only occurs during the identification, switch off the identification if necessary:
Select CONTROL, then INT-EXT, then FUZZY-ID and define whether to switch on or off the identification.

If the fault occurs repeatedly:

⇒ return unit for servicing.

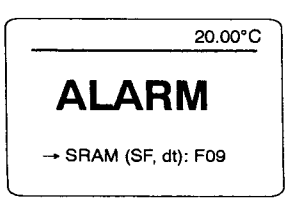
If **fault 5** occurs, this indicates the influence of a high level of external cooling or heating during identification.

⇒ Reduce the influence and try another identification run.

If the fault occurs repeatedly:

⇒ Please contact the Thermo Haake product specialists.

Fault 9: System factors in SRAM invalid



If a set temperature is selected that is less than 5°C above the actual temperature, this set value is reached without identification. In this case the control parameters are taken from the SRAM.

If these values are faulty, they are not accepted by the Fuzzy control, and fault 9 occurs.

⇒ Select a set temperature that is more than 5°C above the actual temperature. This causes the Fuzzy control to carry out an identification in order to determine new control parameters.

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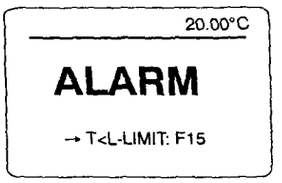
Fault Displays



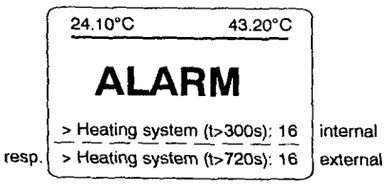
Fault 15: Bath temperature < L-Limit

If the low temperature limit (L-Limit) is changed so that is above the actual temperature, fault 15 occurs.

⇒ In the HIGH/LOW menu select a low temperature limit that is below the actual temperature.

⇒ ALARM is still visible on the display.

⇒ The reset key must be pressed in order to start up the unit again. ALARM disappears on the display and the unit can be operated again.



Fault 16: Heating defective (internal/external control)

During the identification, to determine new control parameters the Fuzzy control measures the time necessary for a temperature step of 1 °C at the control sensor.

If this takes longer than 300 s (internal control) or 720 s (external control), respectively, Fuzzy control assumes a fault in the heating system, so that fault 16 occurs.

⇒ Return unit for servicing.

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16. Testing the Safety Features

The safety features for excess temperature protection and low liquid level protection must be checked at regular intervals. The level of regularity of checking depends on the unit's designated application and the heat transfer liquid used (inflammable or non-inflammable). Practical experience has shown that between 6 to 12 times a year is sufficient.

16.1 Excess temperature protection

Set a cut-off temperature (see chapter 14.1) that is lower than the desired set temperature. Switch on the circulator and check if the circulator really does switch itself off at the set cut-off temperature
If not follow the specifications detailed in chapter 14.1.1.

It may be deemed necessary to have the unit checked over by qualified service personnel.

16.2 Low liquid level protection

Drain the heat transfer liquid **slowly** during operation (use a drain tap if necessary) and check if the unit really does switch itself off.
If not the unit must be checked over by qualified service personnel.

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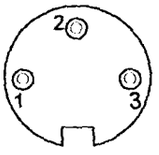
17. External Connections

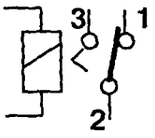
! Only use shielded cable (see chapter 17.5).

17.1 Interface RS232C see chapter 18.

17.2 Remote alarm

ALARM





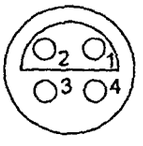
Potential free contact with the following pin assignment:
Pin 1 = make contact
Pin 2 = middle
Pin 3 = break contact

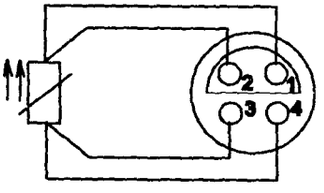
Alarm relay in the circulator:
The relay contacts 2 and 3 are open in case of an alarm and when the instrument is switched off.

Rating: max. 30 V
max. 0.1 A

17.3 External Pt100 sensor

Pt100





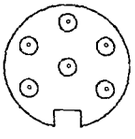
A sensor in four wire technology is necessary. Only sensors with shielded wires can be used to fulfill the EMC requirements. The shielding must be connected with the housing of the plug and the sensor shaft.
This sensor has to be connected according to the wiring diagram.

Pin assignment:
Pin 1 = current I +
Pin 2 = voltage U +
Pin 3 = voltage U –
Pin 4 = current I –

The circulator must be switched off and on again after inserting an external sensor. The function EXTERNAL is otherwise not selectable. The unit switches automatically back to the function INTERNAL.

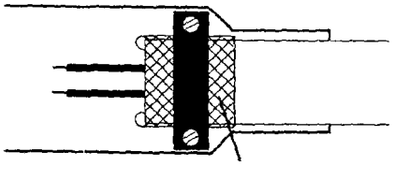
17.4 I/O port (option!)

I / O



This port for analog small voltage will be delivered as an option and is described separately (see appendix).

17.5 Shielded Cables



Attach shielding plane

In order to keep the electromagnetic noise in the instrument within the tolerable limits it is indispensable to use only shielded cables and high quality plug connections. The complete contact of the shielding within the plugs is of special importance. Insufficient contact may lead to noise penetration and result in performance errors.

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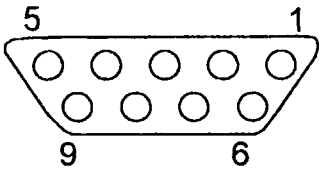


18. RS232C Interface

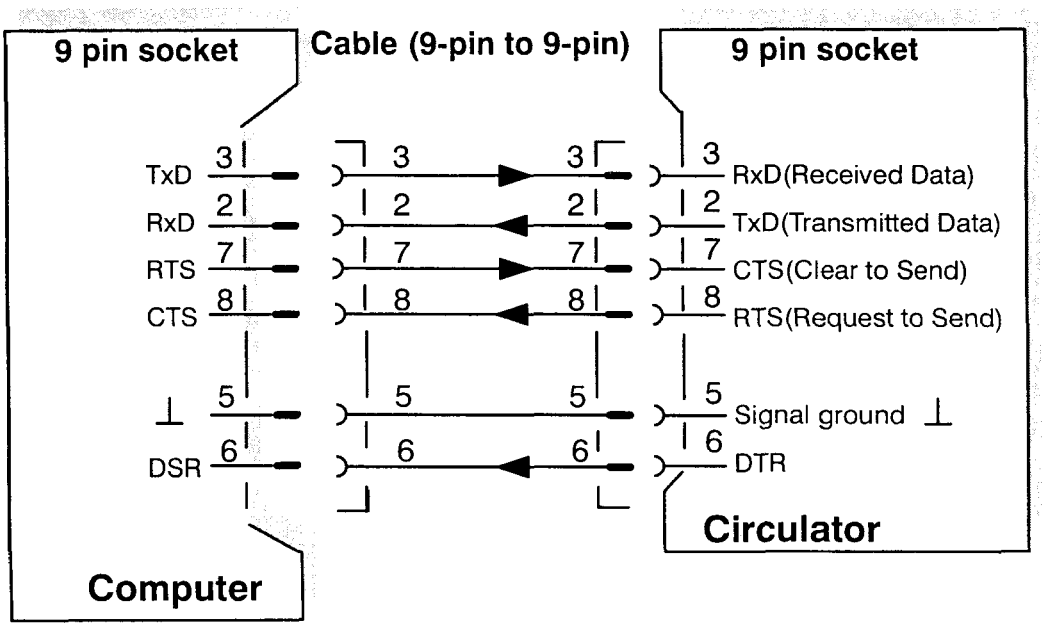
The following circulator functions can be controlled by a computer via the interfaces:

- Setting the desired set temperature, the upper and lower limit temperatures and correction factor is possible;
- the actual temperature can be read off;
- the circulator can be reset, started or stopped;
- any fault messages can also be displayed.

The RS232C interface uses separate lines for sending and receiving data.

18.1 Connecting to a computer with RS232C interface

The pin assignment required when connecting the circulator to a computer via a **9-pin** socket is as follows:



The pin assignment required when connecting via a **25-pin** socket is shown overleaf.

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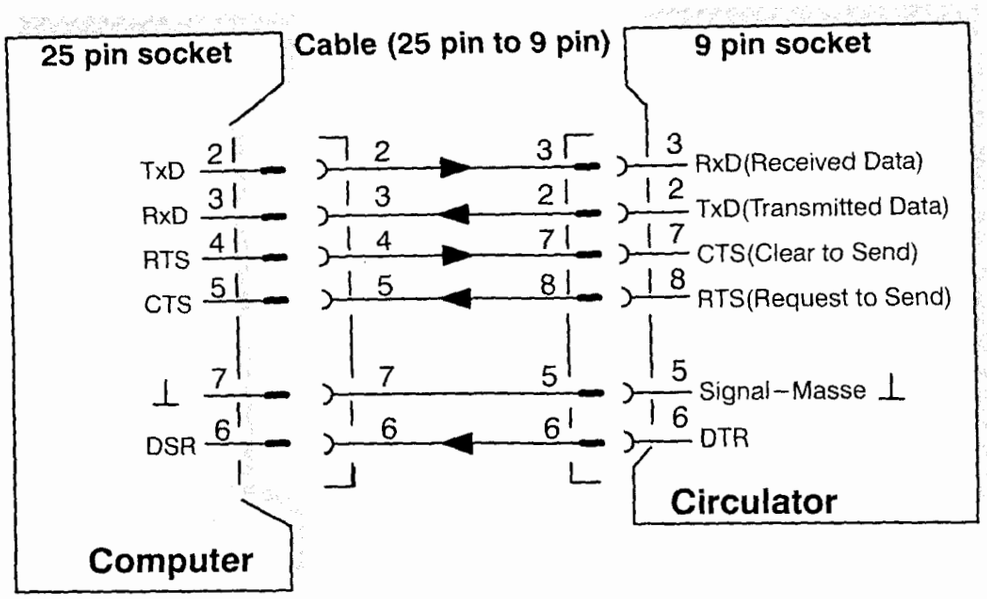
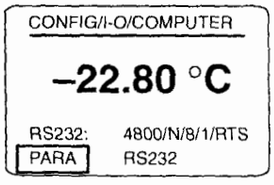
The pin assignment required when connecting the circulator to a computer via a **25-pin** socket is as follows:



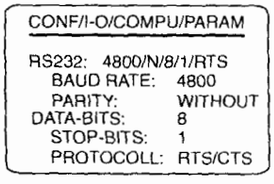
18.2 Interface parameter

Interface parameters can be set via the circulator as follows:

Select the submenu CONFIG in the main menu using the ENTER key. Then select I/O and then COMPUTER.



Then select PARA to set the parameters.



The saved parameters will be listed in the first line. Changes will be done in the following line.

☞ All these transfer parameters **cannot** be altered via the interface.

Maximum baud rate:

Recommendation for the maximum baudrate: **4800 bauds**

The communication between the computer and the circulator should not take place at a baud rate higher than 4800. Occasional transfer failures ca occur at a baud rate of 9600.

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18.3 Requirements made of external units

Only units which have been tested according to EN 60950 (=IEC 950) should be connected to the interface of the circulator.

18.4 Setting the desired set value

If the desired set value is set via the computer, this means:

- If the interface connection is interrupted, the circulator controls the temperature to the last set value entered via the interface.
- After the mains supply current has been switched off and on, the circulator controls the temperature to the last value entered via its keyboard and not the value given by the computer.

18.5 Watchdog function

A watchdog can be initialised via the interface, in order to generate an acoustic alarm when no trigger command has been received via the interface within the set timeout period. The circulator then continues operation with the most recently manually set (via the menu function) setpoint temperature as safety temperature. The most recently received setpoint from the interface is therewith no longer valid. Thus the instrument is not switched-off as it would be in the case of an ordinary disturbance (liquid level, BATH overtemperature, etc.). The response delay time of the watchdog can be changed via the interface. The default setting after switch-on is 20 seconds.

The watchdog (WD) setting is displayed on the menu path

"KONFIG/STATUS/B_STATUS"

WD-V24: 0/0020/+000015

```
                |  |  |---current WD remaining response
                |  |        delay in seconds
                |  |---WD response time setpoint in sec.
                |        (0...9999 sec)
                |---WD status (0 inactive, 1 active)
```

☞ By reference to the WD remaining response delay time indication, after the watchdog has responded, it is possible to determine the instant at which communication failed. This is possible because the residual time is shown with sign. The value is positive for as long as the WD has not responded.

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18.6 Correction value

If the desired correction value is set via the computer, this means:

- If the interface connection is interrupted, the circulator operates to the last correction value entered via the interface.
- After the mains supply current has been switched off and on, the circulator operates to the last value entered via its keyboard and not the value given by the computer.

18.7 Controlling a circulator

The interfaces can be controlled by the user either via a BASIC program or a higher programming language (under DOS) or via the Windows-Terminal (under Winwows 3.1x).

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18.7.1 Controlling via a BASIC program

The range of commands stored in the circulator can be activated by this simple program:

```
REM  command procedure F and N
REM  1. enter command
REM  2. command is passed on to the interface
REM  3. return message will be displayed
CLOSE
OPEN "com1:4800,n,8,1,cs0,ds0,cd0" AS #1
loop:
     INPUT "enter command:";B$
     IF B$="x" THEN goto markend
     zz = 0
     i = 1

     PRINT#1,B$
     rem PRINT
     zz = zz +1
     PRINT "command: ";B$;" -> return message: ";
     rem PRIN$T "------"

     GOSUB enter

     goto loop
markend:
END

enter:
     A$=""
     y = timer
read loop:
     while (instr(A$,chr$(10)) = 0 and timer-y < 12)
          A$ = A$ + input$(loc(1),#1)
     wend
read end:
     print a$;
RETURN
```


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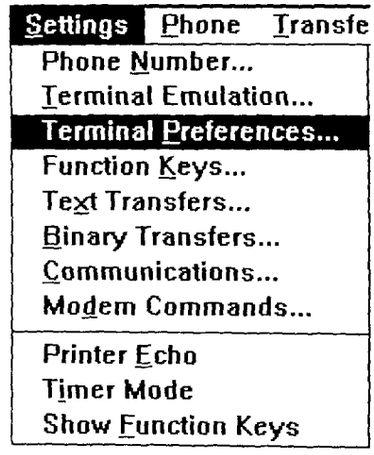
18.7.2 Controlling via Windows-Terminal

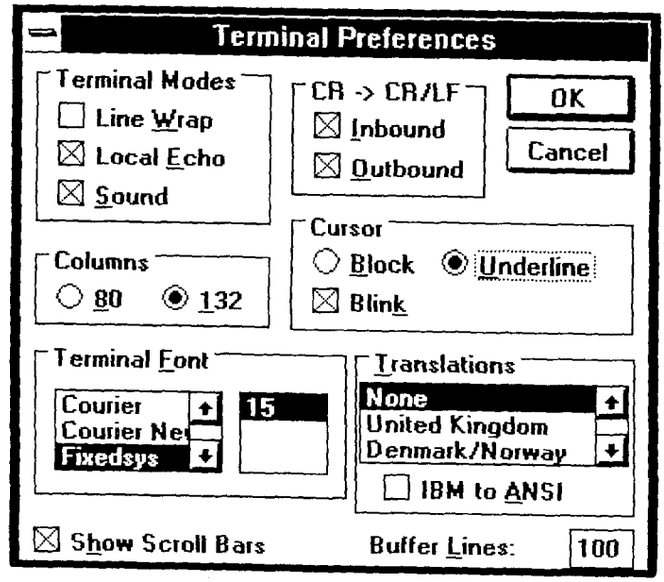
Start the Windows terminal (e.g. by double–clicking the icon "Windows terminal" on the program manager.

Go to the Settings menu, either by double–clicking on "Settings" or entering Alt+S.



In the window "Terminal Preferences" the following settings are recommended (see illustration):

Terminal-Modes:	CR –> CR/LF:
x Local Echo	x Inbound
x Sound	x Outbound



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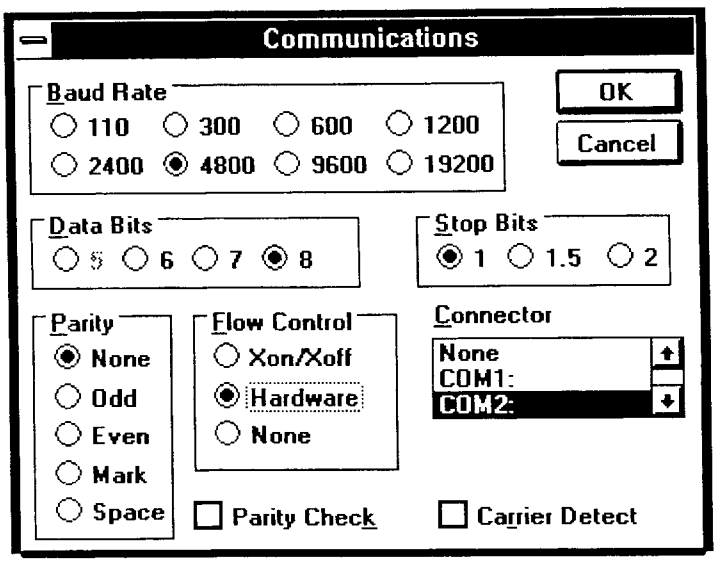
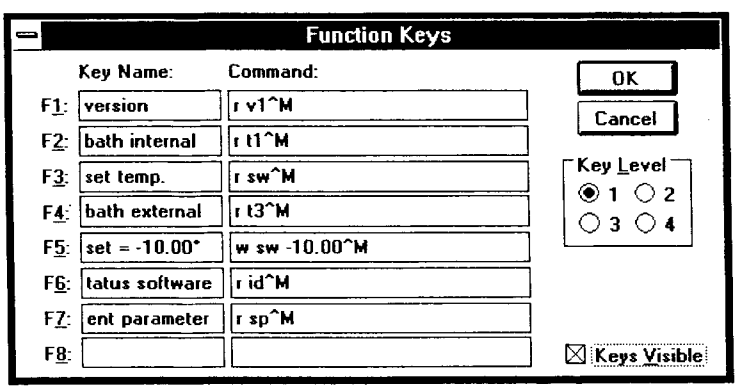
In the window "Communications" do the following settings (see illustration):

Data Bits:	8
Stop Bits:	1
Parity:	None
Flow Control:	Hardware
Baud Rate:	4800 Baud

☞ Select the same Baud rate on the PC and on the circulator (see 18.2).



In the window "Function keys" you can define function keys for the commands described in 18.8. Below one of four key levels is shown.



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18.8 Sets of commands

For the communication there are three different sets of commands. Commands of the different sets can be combined at will.

- Standard set of commands
- Extended set of commands
- Set of commands according to NAMUR.

☞ **In the following table a blank is represented by a "_",** for example "R_V1" or "S__*<value>*"

☞ **Every command must be confirmed with** <cr>.

☞ **For all three sets of commands there is no difference between upper case and lower case letters.** I.e. there is no difference between entering "start", "Start", "START" or "StArT".

☞ **In case of the "standard set of commands" be sure to keep the right number of digits when entering a value.**

☞ **In case of the "extended set of commands" and the "set of commands acc. to NAMUR", empty places need not be filled with "0" (in contrast with the "standard set of commands").**

☞ ***Only with F8/N8:***
The header "ADR" followed the unit address must precede every command in case of subsequent programming (see 18.2).
E.g. for RESET: **ADR07**RS<cr>.

Standard set of commands:

If you have already controlled a circulator DC5 via the PC you can use the same set of commands for the circulators of the F6/N6 and F8/N8 line.

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Serial Interface

Standard	Extended	NAMUR	Command
V	R_V1	-	**Version** ... of the operating software
B - - -	R_BS R_AM R_FB R_FE	- - - -	**Operating status** call up fault messages (18.9) call up first triggered alarm call up fuzzy control call up fuzzy error number
I or F1 F2	- -	IN_PV_1 IN_PV_2	**Actual temperature** Call up actual temperature (internal) actual temperature (external)
S S__<*value*>	R_SW W_SW_<*value*>**)	IN_SP_1 OUT_SP_1___<*value*>	**Set temperature** (resolution 0,01°C) Call up set temperature Select set temperature *)
<*value*> = {00000 ... 20000} => 0°C ... 200,00°C <*value*> = {00000 ... -5000 } => 0°C ... -50,00°C e.g.: set temperature= 20,0°C => "S__02000" set temperature= -10,5°C => "S -1050"; "-" replaces 1st digit			
C CE C__<*o.s.*><*value*> CE_<*o.s.*><*value*>	R_CI R_CE W_CI<_*value*>**) W_CE_<*value*>**)	IN_SP_2 IN_SP_4 OUT_SP_2___<*value*> OUT_SP_4___<*value*>	**RTA (correction factor c)** (resolution 0,01°C) Call up RTA (internal) Call up RTA (external) Set RTA (internal) Set RTA (external)
<*o.s.*> = {+,-}; operational sign <*value*> = {0000 ... +/-0255} => 0°C ... +/-2,55°C "blank" and "+" can be used as positive signs, e.g.: c = 1,23°C => "c__0123" or "c_+0123"			
HL LL - -	R_HL R_LL W_HL_<*value*>**) W_LL_<*value*>**)	IN_SP_6 IN_SP_7 - -	**Temperature limit values** (resolution 0,01°C) Call up high limit temperature Call up low limit temperature Set high limit temperature Set low limit temperature

" _ " = blank

*) If a new nominal temperature is preset over the digital interface as long as there is another value preset over the analog I/O port or the built-in programmer the error "F136-PG-I/O-SOLL-ERROR" will be displayed. The program sequence is interrupted and the desired set temperature is activated whilst the start temperature is being reached or the program is set to "pause".

**) at values with decimal places, put in a point e.g. 20.01 (no comma!!!)

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Standard	Extended	NAMUR	Command
AL	W_AL	OUT_MODE_4_0 OUT_MODE_4_1	**Alarm** ... triggering (main relay missing, heating and pump off) Alarm confirming
ER	W_EG		**Unlocking** ... after switching on or fault
			ENTER key

The ENTER key can be locked if the circulator is controlled via the PC. This prevents values set via the interface from being accidentally altered at the circulator. The key functions ←, →, ↓, ↑ and MENU remain available. Alterations can however no longer be confirmed with the ENTER key.

L U	W_L W_U	OUT_MODE_3_0 OUT_MODE_3_1	Switching to REMOTE operation and blocking the ENTER key (Lock) Switching from REMOTE operation and releasing the ENTER key (Unlock)
GO ST	W_TS0 W_TS1	OUT_MODE_5_0 OUT_MODE_5_1	**Unit ON/OFF** Heating and pump ON Heating and pump OFF (since V:1.052)
- - -	- W_SR W_ER	IN_MODE_5 0: control OFF 1: control ON START	**Control ON/OFF** Call up control ON/OFF Start control Stop control
- IN EX	- W_IN W_EX	IN_MODE_2 0: internal 1: external OUT_MODE_2_0 OUT_MODE_2_1	**Internal/external control** Call up internal/external control Switching to INTERNAL control Switching to EXTERNAL control
- - -	R_FR W_FR_0 W_FR_1	- - -	**Folgereg on/off** call up status OFF ON

"_" = blank

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Standard	Extended	NAMUR	Command
			Autostart
-	R_ZA	-	call up status
-	W_ZA_0	-	OFF
-	W_ZA_1	-	ON
			Fuzzy ID
-	R_Zi	-	identification call up status
-	W_Zi_0	-	OFF
-	W_Zi_1	-	ON
			BEEP Programmer
			(only F8/N8)
-	R_ZB	-	call up status
-	W_ZB_0	-	OFF
-	W_ZB_1	-	ON
			Cooling management
-	R_ZK	-	call up status
-	W_ZK_0	-	OFF
-	W_ZK_1	-	ON
			Real time clock
			(only F8/N8)
-	R_XT	-	Call up time
-	R_XD	-	Call up date
-	W_XD_*<HH>*_*<MM>*_*<SS>*		Select time
-	W_XD_*<DD>*_*<MM>*_*<YY>*		Select date
			Temperature scale
-	W_TEC	-	Select Celsius
-	W_TEK	-	Select Kelvin
-	W_TEF	-	Select Fahrenheit
			Watchdog
-	W_WD_1	-	ON
-	W_WD_0	-	OFF
-	R_WD	-	Call up status WD0: inactive WD1: active
-	W_WS_<cr>	-	Specifies the setpoint for watch-dog response time in 2 sec. raster
-	R_WS	-	Call up setpoint
			Cooling
-	R_CC	-	call up status
-	W_CC_0	-	OFF
-	W_CC_1	-	ON

" _ " = blank

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Standard	**Extended**	NAMUR	**Command**
			Ramp parameters

With the **extended set of commands** a temperature program with six ramp segments can be defined. For every segment four parameters must be set:

- Segment number
- Start temperature of the segment
- End temperature of the segment
- Segment time

These parameters can be entered separately or in one line.

Standard	**Extended**	NAMUR	**Command**
	After selection of the segment number, the start and end temperature and the segment time can be entered in any order. **Fault F123** = "RANGE ERROR" If a value is entered that is out of the temperature limit, error message "F123" appears. After that enter a correct value.		
–	W_SN<*no.*>	–	Select **segment nummer** (no.: 1–6)
–	W_SS<*value*>	–	Set **start temperature**
–	W_SE<*value*>	–	Set **end temperature**
	The start and end temperature of the segment (in °C, resolution 0,01°C) must be between the high and the low limit temperature of the circulator (see 13.6).		
–	W_SD<*time*>	–	Set **segment time** (in s, resolution 0,01 s; minimum 0 s, maximum 86,400 s = 24 hour)
–	R_SP<*no.*>	–	Call up parameters of segment <no.>
–	W_SP<*no.*>_<*start*>_<*end*>_<*time*>		Set **all parameters** of segment<no.>
–	W_AS<*no.*>	–	**Run segment** Run to start temperature (segment no.: 1–6)
	Before starting a segment first enter W_ASxx. Then the circulator runs to the start temperature of the segment.		

" _ " = blank

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Standard	**Extended**	NAMUR	**Command**
	Fault F126 = "RAMP ERROR"		
	If you select a segment for which not all the parameters have been defined, error message "F126" appears. In this case either select another segment or define the parameters.		
-	W_RS	-	Start ramp
	If the circulator has reached the start temperature, you can start the ramp with W_RS.		
-	W_RB	-	Stop ramp
-	W_RP	-	Interrupt ramp
	You can interrupt the program with W_RP. Then the segment time is hold and the momentanous temperature is maintained. The interrupted program can either be continued with W_RS or another segment can be selected with W_SNxx.		
	Fault F127 = "PAUSE ERROR"		
	The command W_RP "interrupt ramp" is only available while a program is running, i.e. if the commands W_AS_<no.> "run to start temperature" or W_RS "start rampe" have been entered before.If this is not the case "F127" appears when entering the command W_RP "interrupt ramp".		
	! If a ramp segment runs out, the next segment does not start automatically.		
	To start the next ramp segment, once again enter the following commands:		
-	W_AS_*<no.>*	-	Run to start temperature (segment no.: 1-6)
-	W_RS	-	Start ramp
	Fault F001 = "COMMAND UNKNOWN "		
	If a command is entered that is not defined in any set of commands, error message F001 appears. In this case enter one of the commands listed above.		
	The single ramps can be repeated cyclically:		
-	R_RZ	-	Call up number of cycles
-	W_RZ_*<PgNo.>*_*<number>*	-	Set number of cycles
	Call up for information:		
-	R_RI	-	Read remaining ramp time and internal sensor value.
-	R_RE	-	Read remaining ramp time and external sensor value.
-	R_XR	-	Read status ramp continuation
	Answer „ XR_< program no. >_< segment no. >_< segment remain time >_ < setpoint step >_< actual ramp setpoint >_< segment end temperature > „		

" _ " = blank

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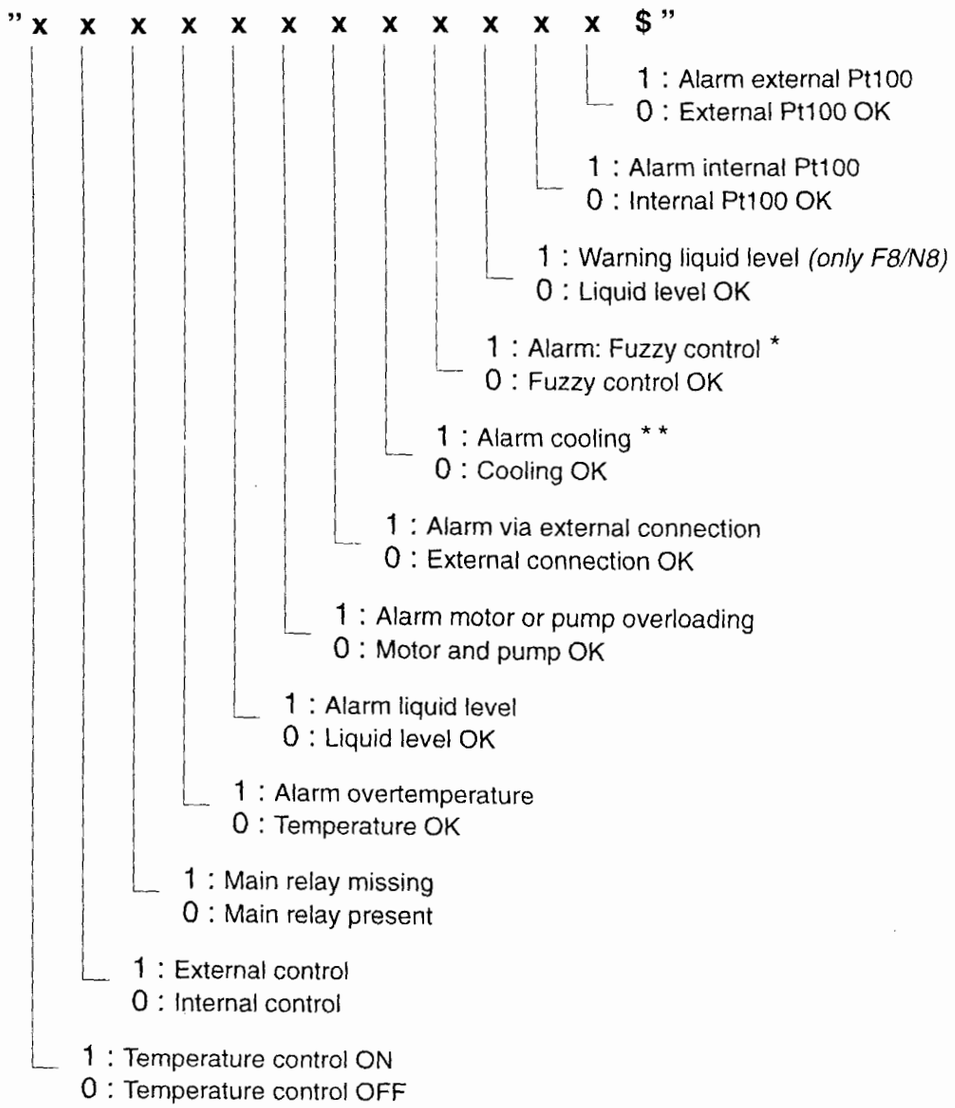
18.9 Operating status / Error message

Call up operating status:
Standard set of commands: B<cr> or
Extended set of commands: R_BS<cr>

After entering one of these commands, the following twelve "state flags" are shown:


" x x x x x x x x x x x x $ "
1 : Alarm external Pt100
0 : External Pt100 OK
1 : Alarm internal Pt100
0 : Internal Pt100 OK
1 : Warning liquid level (only F8/N8)
0 : Liquid level OK
1 : Alarm: Fuzzy control *
0 : Fuzzy control OK
1 : Alarm cooling * *
0 : Cooling OK
1 : Alarm via external connection
0 : External connection OK
1 : Alarm motor or pump overloading
0 : Motor and pump OK
1 : Alarm liquid level
0 : Liquid level OK
1 : Alarm overtemperature
0 : Temperature OK
1 : Main relay missing
0 : Main relay present
1 : External control
0 : Internal control
1 : Temperature control ON
0 : Temperature control OFF

*) With the command R_FE the number of the individual Fuzzy-Error can be read (error list see chapter 15.9)

* *) see next page

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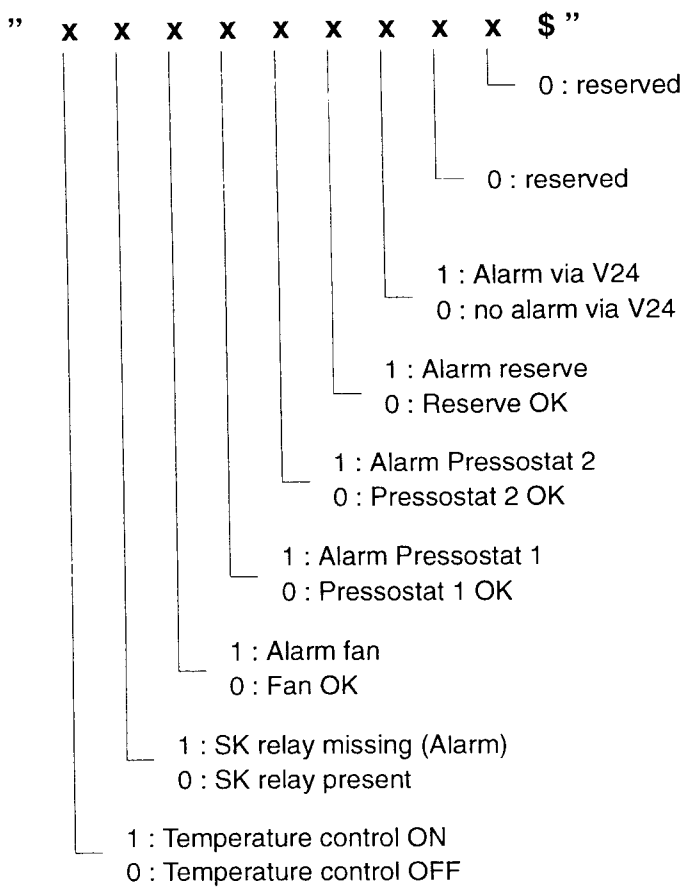
* *) Individual indication of the occurred fault in the cooling management:

Call up operating status of cooling:
Extended set of commands: R_BK


" x x x x x x x x x $ "
0 : reserved
0 : reserved
1 : Alarm via V24
0 : no alarm via V24
1 : Alarm reserve
0 : Reserve OK
1 : Alarm Pressostat 2
0 : Pressostat 2 OK
1 : Alarm Pressostat 1
0 : Pressostat 1 OK
1 : Alarm fan
0 : Fan OK
1 : SK relay missing (Alarm)
0 : SK relay present
1 : Temperature control ON
0 : Temperature control OFF

18.10 Example definition of a ramp program by PC

The comfortable programmer functions integrated in the F8 and N8 instruments can also be controlled by PC through the RS232C interface.

1. Select the **number for the program** you would like to define (max. 4 programs possible):

   W_RN_<**program no.**>
   Space Bar — *1 ... 4*

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2. Then define the **number of segments** the program should have and the **number of program cycles**. Max. 6 segments can be defined for one program. A program can be repeated up to 90 times (i.e. 90 program cycles):

W␣SP␣Ø␣<**number of segments**>␣Ø␣<**number of cycles**>
1 ... 6 *1 ... 90*

Up to 4 ramp functions can be linked together. In order to do this a value > 90 must be entered for the cycle number of the ramp function 1. The following ramp functions must have the value 1 for the cycle number. The number of ramp repetitions can be selected between 1 and 9, according the cycle numbers between 91 and 99.

3. A segment number will automatically be assigned to the programmed segments. Now you can enter the following parameters for each **segment number**:

- the **start** temperature of the segment
- the **end** temperature of the segment
- the **run time** of the segment in seconds (≥1)

W␣SP␣<**segment no.**>␣<**start**>␣<**end**>␣<**run time**>

Example: segment no. 1

start	=	23.0°C
end	=	27.0°C
run time	=	600 sec

W␣SP␣1␣23.0␣27.0␣600

All other segments can be defined accordingly. Please note that the temperature program is continual for all defined segments. This means that the end temperature of segment i must be the start temperature of segment i+1.

4. Start the program by entering the respective program no. (This START command corresponds to the START of the ramp via the menu function):

W␣RV␣<**program no.**>

This will transfer the program from the PC to the circulator. The PC can now be switched off or be used for other tasks. The interface cable can be unplugged from the circulator.

After switching off the circulator the programs are lost.

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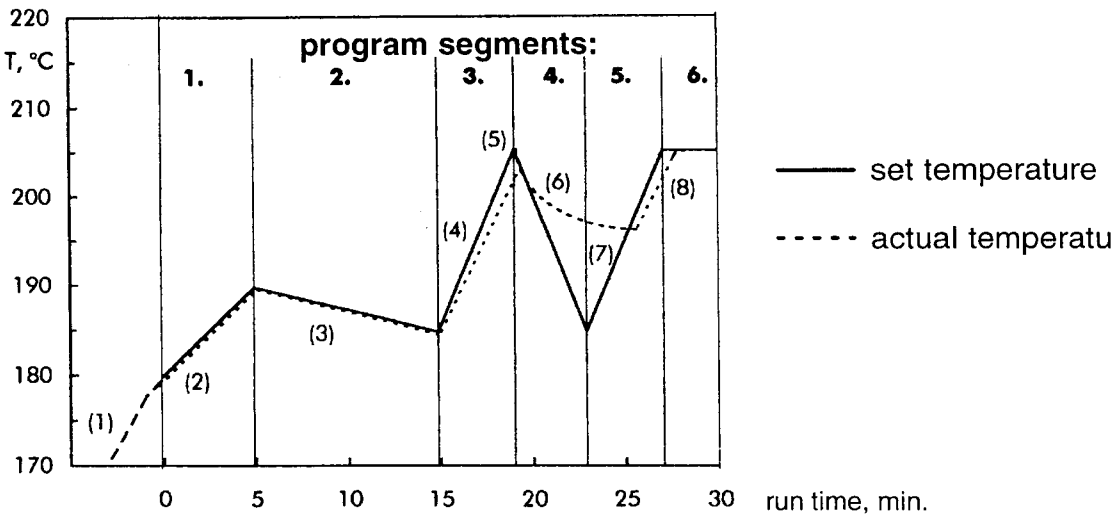
Example of a program: Program no. 3 with 6 segments and 23 program cycles

1.) W_RN_3

2.) W_SP_0_6_0_23

3.) W_SP_1_180.0_190.0_300
W_SP_2_190.0_185.0_600
W_SP_3_185.0_205.0_240
W_SP_4_205.0_185.0_240
W_SP_5_185.0_205.0_240
W_SP_6_205.0_205.0_180

4.) W_RV_3



(1) After starting the program the heating is switched off and control parameters are determined. Then the heating is activated to reach the start temperature of segment no. 1.

(5) At the end of the segment the actual temperature is still below the end temperature, when the program starts segment no. 4. A negative temperature gradient is available. As long as the momentary set temperature is higher than the actual temperature at the beginning of the segment the unit heats until the two temperature curves intersect.

(6) At this point the heating is inactivated. The temperature decrease given in segment no. 4 is too fast for a circulator without cooling aggregate. Thus the actual temperature decrease is slower than the set temperature.

☞ **The times of segments no. 3 and no. 4 should be extended so that the circulator can keep the given values.**

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19. Cooling

The refrigerated bath is used mainly for enabling lower than ambient or tap water temperatures in circulators or for cooling a heated bath down to a low temperature level very quickly.

The working temperature range is shown in the technical specifications.

☞ **Safety measures have been taken in order to avoid an excessively high temperature in the cooling circuit which would then result in the excess temperature protection being triggered and the compressor being switched off.**

The cooling capacity is controlled according to the heat removal requirements. If the unit works continuously at high working temeratures, the cooling machine will be switched off.

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20. Maintenance

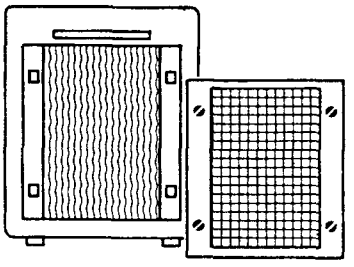
The stainless steel surfaces of the bath vessel and of the housing may after some time show spots and become tarnished. Normal stainless steel cleaners as they are used in the kitchen can be used. The bath vessel and built-in components should occasionally (at least every time the bath liquid is changed) be cleaned using a household cleaner. Vinegar-based cleaners have proved to be suitable used according to the manufacturers recommendations.

☞ **Do not use scouring powder!**

The inside of the bath vessel must be kept clean in order to ensure a long service life. Substances containing acidic or alkaline substances and metal shavings should be removed quickly as they could harm the surfaces causing corrosion. If corrosion (e.g. small rust marks) should occur in spite of this, cleaning with stainless steel caustic agents has proved to be suitable. These substances should be applied according to the manufacturers recommendations.

20.1 Cleaning the fins of the liquefier

In order to maintain the cooling capacity of the unit, cleaning has to be done two to four times per year, depending on the grade of soiling.



! **Switch off the unit and pull out the mains plug.**

1. Loosen the ventilation grid on the front: Rotate the mounting screws 90° in any direction and remove grid.
2. Clean fins with brush or similar tool.
3. Replace grid and push screws back in (do not rotate screws).

20.2 Discarding the unit:

One day the life span of your cooling unit will end.
Therefore:

! **The units contain the ozone-friendly coolants R134a, R404A or R23. The units may however only be discarded by authorized personnel.**

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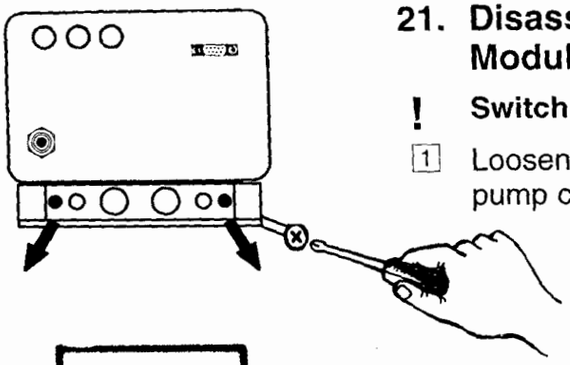
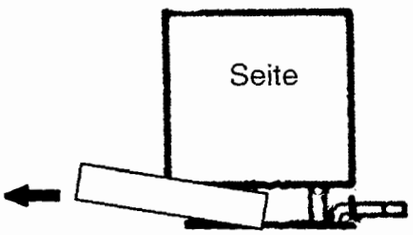


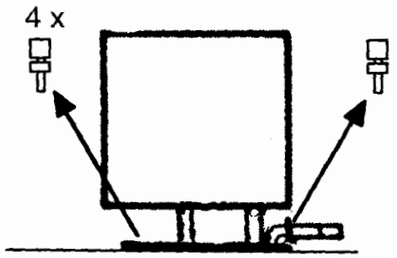
21. Disassembly of Temperature Control Module and Bath Vessel

! **Switch off the unit and pull out the mains plug.**

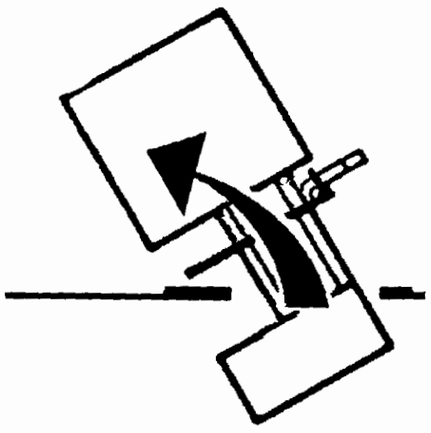
[1] Loosen the 2 crosshead screws right beside the pump connections.



[2] Slide the metal jacket to the front (slightly bending may be necessary) and remove it.

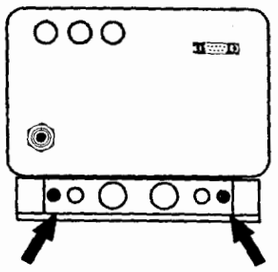


[3] Unscrew the 4 screws. A hexagon socket (10 mm) should be used if the screws are too tightly tightened.
In case of difficulty loosen the sealing from the unit with a screw driver.



[4] Incline the unit slightly whilst lifting it.

! **Lift the float to avoid any damage.**



[5] Fix the jacket again with the 2 crosshead screws.

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22. Technical Specifications

22.1 Bridge Circulators

Technical specifications acc. to DIN 58966		F6-H51	N6-H51
Working temperature range with tap water cooling with other cooling	°C °C °C	35..250 20..250 -60..250	45..300 20..300 -60..300
Temperature accuracy	±K	0.01	0.01
Heater capacity 230 V / 115 V	W	2000/1000	3000/–
Pump: Pressure/Flow rate max. Suction/Flow rate max.	mbar/ l/min mbar/ l/min	300/20 210/15	540/31 420/20
Immersion depth from..to	mm	90..145	100..195
Width of the bath bridge from..to	mm	300..800	300..800
Overall dimensions: WxLxH	cm	30x15x33	30x15x39
Net weight	kg	6.9	10.0
Total wattage 230 V / 115 V	VA	2100/1100	3100/–
Order no. for 230 V / 50..60 Hz for 115 V / 60 Hz		404-0511 404-0512	406-0511 –

22.2 Heating Circulators

Technical specifications acc. to DIN 58966		F6-B5	N6-B7	N6-B12
Working temperature range with tap water cooling with other cooling	°C °C °C	38..250 20..250 -60..250	45..300 20..300 -60..300	45..300 20..300 -60..300
Temperature accuracy	±K	0.01	0.01	0.01
Heater capacity 230 V / 115 V	W	2000/1000	3000/–	3000/–
Pump: Pressure/Flow rate max. Suction/Flow rate max.	mbar/ l/min mbar/ l/min	300/20 210/15	540/31 420/20	540/31 420/20
Bath opening: WxLxD	cm	14x15x15	13x10x20	22x14x20
Bath volume	l	4.5	7	12
Overall dimensions: WxLxH	cm	21x36x37	23x36x46	32x38x46
Net weight	kg	11.0	16.0	17.5
Total wattage 230 V / 115 V	VA	2100/1100	3100/–	3100/–
Order no. for 230 V / 50..60 Hz for 115 V / 60 Hz		404-0051 404-0052	406-0071 –	406-0121 –

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22.3 Refrigerated Circulators

Technical specifications acc. to DIN 58966		F6-C25	F6-C35	F6-C40	N6-C20	N6-C41	F6-C50
Working temperature range	°C	-28..150	-35..200	-40..150	-30..200	-40..150	-47..200
Temperature accuracy	±K	0.01	0.01	0.01	0.01	0.01	0.01
Heater capacity 230 V	W	2000	2000	2000	2000	2000	2000
115 V	W	1000	1000	1000			
Cooling capacity at 20°C	W	300	400	700	800	1000	850
at 0°C	W	200	300	550		750	700
at -20°C	W	70	150	300		400	500
Pump:							
Pressure/Flow rate max.	mbar/ l/min	300/20	300/20	300/20	540/31	540/31	300/20
Suction/Flow rate max.	mbar/ l/min	210/15	210/15	210/15	420/20	420/20	210/15
Bath opening: BxLxT	cm	13x10x15	22x14x15	29x15x15	22x14x20	29x15x20	22x14x15
Bath volume	l	4.5	8	12	12	15	8
Overall dimensions: WxLxH	cm	23x46x60	38x46x68	38x46x74	38x46x74	38x46x75	38x46x74
Net weight	kg	32.0	39.0	45.0	52.0	52.0	48.0
Total wattage 230 V	VA	2450	2500	2500	2600	2600	2650
115 V	VA	1450	1500				
Order no. for 230 V / 50..60 Hz		414-0251	414-0351	414-0401	416-0201	416-0411	414-0501
for 115 V / 60 Hz		414-0252	414-0352	–	–	–	–

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22.4 Fuse values

Unit type	Mains voltage	Fuse(s)at the rear panel	Fuse(s) in the unit
F6/2KW	230V	2x10 A	1xT125 mA/1xT200 mA
F6/2KW/Cool	230V		1xT125 mA/1xT200 mA
F6/1KW/Cool	230V		1xT125 mA/1xT200 mA
F6/1KW	115V	1x13 A	1xT200 mA/1xT200 mA
F6/1KW/Cool	115V		1xT200 mA/1xT200 mA
N6/3KW	230V	2x15 A	1xT125 mA/1xT200 mA
N6/2KW/Cool	230V		1xT125 mA/1xT200 mA
N6/3KW/Cool	230V		1xT125 mA/1xT200 mA
C25	230V	2x10 A/2x6 A	1xT400 mA
	115V	1x12 A/1x6 A	1xT315 mA
C35	230V	2x10 A/2x8 A	1xT400 mA
	115V	1x12 A/1x8 A	1xT315 mA
C20	230V/50Hz	2x10 A/2x6 A	1xT400 mA
	220V/60Hz	2x10 A/2x6 A	1xT315 mA
C40	230V/50Hz	2x10 A/2x6 A	1xT400 mA
	220V/60Hz	2x10 A/2x6 A	1xT315 mA
C41	230V/50Hz	2x12 A/2x6 A	1xT400 mA
	220V/60Hz	2x12 A/2x6 A	1xT315 mA
C50	230V/50Hz	2x10 A/2x6 A	1xT400 mA
	220V/60Hz	2x10 A/2x6 A	1xT315 mA

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23. Optional I/O board (order no. 333-0531)

23.1 Installation of I/O Board

! The installation may only be done by trained personnel.

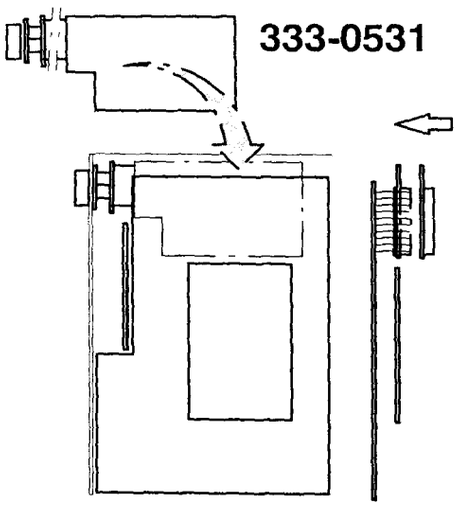
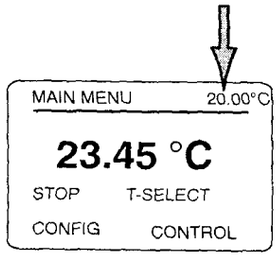


Fig. 1

1. **Disconnect instrument from mains** (unplug mains plug)
2. Unscrew the cover caps of the sockets at the rear instrument panel.
3. Remove screws at the rear panel (4 screws).
4. Remove rear panel.
5. Bend the hood slightly apart and slide off to the back.
6. Separate the socket of the I/O board at the rated break point. Insert I/O board as shown in Fig. 1.
   (Insert PCB up to the stop of the pin strip)
   Fasten socket on housing with a nut (watch torsion protection).
7. Slide hood back on.
8. Check grounding connections.
9. Screw the rear panel back on.



! For connection with the voltage or mains supply a shielded cable has to be used.

Should you notice any jumps of the set temperature values on the display the shielding is insufficient. Please shield as described in the manual (chapter 17.5). If the problem persists (e.g. in case of a longer cable) the cable should perhaps be embedded in a tube.

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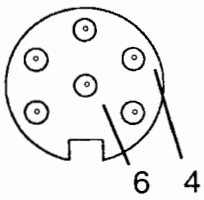
23.2 Pin assignment

View from soldering side

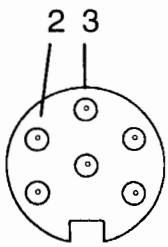


23.2.1 Signal input

For signal input the socket has the following pin assignment:

4 = reference input + (set value),
6 = reference input – (set value).

Working resistance for current input: < 150 Ω,
Input impedance for voltage input: > 50 kΩ.



23.2.2 Signal output

For signal output the socket has the following pin assignment:

2 = measuring value + (actual value),
3 = measuring value – (actual value).

Working resistance for current input: < 500 Ω,
Output impedance for voltage input: > 10 kΩ.

For the operation of the circulator with an analog low voltage normal signal via the I/O port you can choose between

1) voltage input,
2) voltage output,
3) current input and
4) current output.

I.e. with this interface you can

- define set values (voltage and current input) and simultaneously
- show actual values (voltage and current output)

of an external device.

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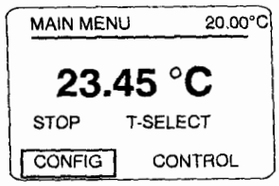
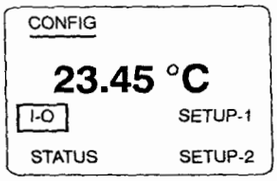
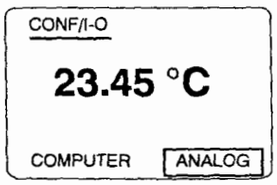


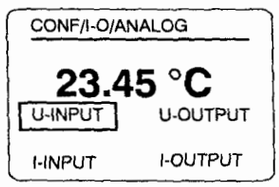
23.3 Configuration

To configure the I/O port, select I-O in the CONFIG menu and confirm with ENTER.





If an I/O board is built in, you can choose either COMPUTER or ANALOG in the I-O menu. Select ANALOG and confirm with ENTER.



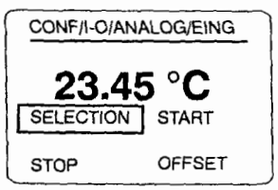
Here four possibilities are available for selection:

U-INPUT, U-OUTPUT,

I-INPUT and I-OUTPUT.

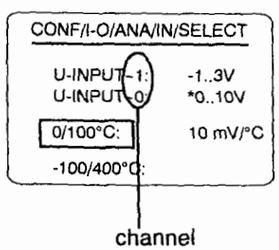
(U = voltage, I = current)

23.3.1 Configuration of voltage input



If you want to give a set value with an analog voltage signal by means of an external device, select U-INPUT (voltage input) in the ANALOG menu and then SELECTION in the INPUT menu to set the values for the voltage input.

When the SELECTION menu appears three different combinations of values (channels 0 to 2) can be set: the modes normal resolution (-100...400°C) and high resolution (0...100°C) with the voltage range 0...10 V and the standardised Thermo Haake interface -1...3 V (10 mV/°C; 0,0 V = 0,0°C):



a) 0...10 V = 0...100°C (channel 0)
b) -1...3 V = 10 mV/°C (-100...300°C) (channel 1)
c) 0...10 V = -100...400°C (channel 2)

! If an older Thermo Haake circulator that was operated with analog temperature input is replaced simply select -1...3 V and 10 mV/°C. Doing so the former parameters are set automatically.

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In the other case select 0...10 V and the temperature range 0...100°C or –100...400°C in the U-INPUT.

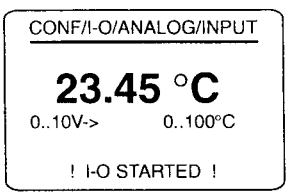
On the display the following is shown (from top to bottom):

Upper line U-INPUT: the momentarily saved mode (e.g. U-INPUT-1: –1...3V) with the channel (e.g. 1) and the voltage range (e.g. –1...3V);

Lower line U-INPUT: the momentarily marked mode (e.g. U-INPUT-0:*0...10V) with the channel (e.g. 0) and the voltage range (e.g. 0...10V);

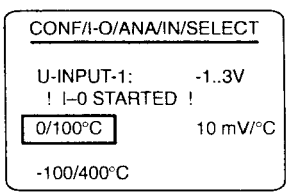
Below: the available modes (e.g. 0...100°C, 10 mV/°C, –100...400°C).

With the arrow keys you can select a mode. The respective voltage range and channel are shown in the lower line U-INPUT. If you confirm this selection (i.e. this channel) with ENTER, the information is taken over to the upper line U-INPUT.



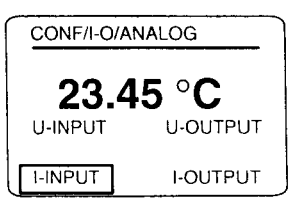
Press the menu key to get to the INPUT menu. Here with START you can activate the defined voltage values. From now on the circulator will receive its set values via the pre-set voltage values.

For a short time in the display appears "! I-O STARTED!" together with the set values (e.g. 0...10V → 0 ...100°C).



! If a channel is momentarily active, it is not possible to save a new setting: while you press the ENTER key, "! I-O STARTED !" is shown on the display. To save a new setting first stop the operation of the I/O plug with STOP in the INPUT or OUTPUT menu.

23.3.2 Configuration of current input



If you want to give a set value with an alalog current by means of an external device, select I-INPUT (current input) in the ANALOG menu and then SELECTION in the INPUT menu to set the values for the current input.

When the SELECT menu appears two different modes can be chosen: normal resolution (–100...400°C) and high resolution (0...100°C). So with the current ranges 0...20 mA or 4...20 mA four combinations (channels 4 to 7) are available:

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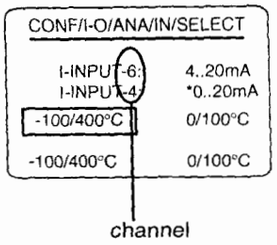
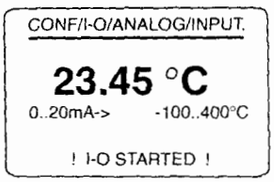




a) 0...20 mA = −100...400°C (channel 4)
b) 0...20 mA = 0...100°C (channel 5)
c) 4...20 mA = −100...400°C (channel 6)
d) 4...20 mA = 0...100°C (channel 7)

Select the temperature range with the arrow keys and choose 4...20mA or 0...20mA in the lower line I-INPUT.

Press the menu key to get back to the INPUT menu. Here with START you can activate the selected values to start the input via the I/O port. From now on the circulator will receive its set values via the pre-set current.

For a short time "! I-O STARTED !"is shown on the display with the selected values (e.g.: 0...20 mA, −100...400°C).

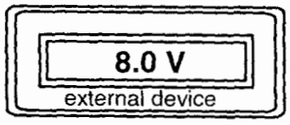
! "! I-O STARTED !" is shown on the display also if you try to start the programmer (only F8 and N8) while the I/O plug is active.
To start the programmer first stop the operation of the I/O plug with STOP in the INPUT or OUTPUT menu.

23.3.3 Adjusting the input values

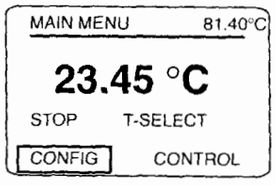
If you give a set value by means of an external device via the I/O plug, there can be a difference between the set temperature shown on the display of the circulator and the set value on the external device.

This difference depends on tolerances in the I/O board and the external device.

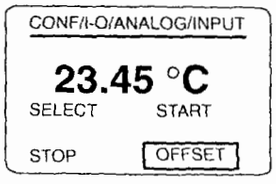
By setting an offset value, the value (i.e. a voltage or a current, respectively) shown on the external device can be adjusted to the temperature shown on the display of the circulator.



E.g.: voltage input and the normal resolution mode (0...10 V = 0...100°C; channel 1) is selected. On the external device 8.0 V is set to give a set temperature of 80°C.



Due to some tolerance, the set temperature on the display of the circulator is not 80.00°C but 81.40°C. (The set temperature is always in the upper right corner of the display.)



This difference can be adjusted with an offset of −1.40°C.

To set the offset get back to the INPUT menu with the MENU key and there select OFFSET.

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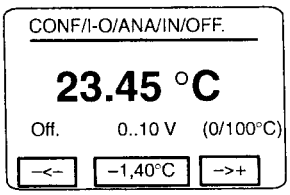


In the OFFSET menu you can set the offset value (i.e. the difference between the two temperatures) with the arrow keys ← and →.

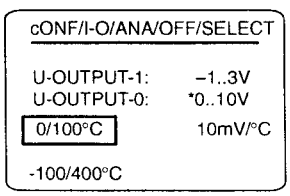
After this, the value on the external device and the set temperature on the display of the circulator are adjusted.

Confirm with ENTER to save the offset value.

On the display the voltage or current range of the selected mode is shown (e.g. 0...10V, 0/100°C). For each channel an offset value can be saved.

23.3.4 Configuration of voltage output

If you want to monitor an actual value (i.e. an actual temperature) with an alalog voltage signal by means of an external device, select U-OUTPUT (voltage output) in the ANALOG menu and then SELECTION in the OUTPUT menu to set the values for the voltage output.



The configuration of U-OUTPUT is similar to the one of U-INPUT. You can choose between the same modes:

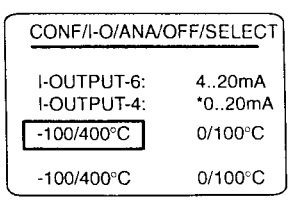
a)	0...10 V = 0...100°C	(channel 0)
b)	−1...3 V =10 mV/°C (−100...300°C)	(channel 1)
c)	0...10 V =−100...400°C	(channel 2)

The display shows OUTPUT in stead of INPUT.

23.3.5 Configuration of current output

If you want to monitor an actual value (i.e. an actual temperature) with an alalog current signal by means of an external device, select I-OUTPUT (current output) in the ANALOG menu and then SELECTION in the OUTPUT menu to set the values for the current output.

The configuration of I-OUTPUT is similar to the one of I-INPUT. You can choose between the same combinations of output current ranges and temperature ranges (channels 4 to 7):



a)	0...20 mA = −100...400°C	(channel 4)
b)	0...20 mA = 0...100°C	(channel 5)
c)	4...20 mA = −100...400°C	(channel 6)
d)	4...20 mA = 0...100°C	(channel 7)

The display shows OUTPUT in stead of INPUT.

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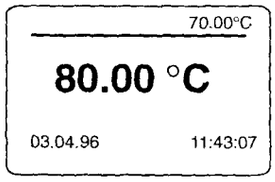
23.3.6 Adjusting the output values

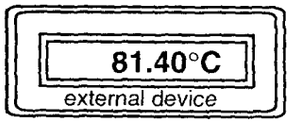
Similar to the input of set values, when monitoring an actual value by means of an external device via the I/O plug, there can be a difference between the actual temperature shown on the display of the circulator and the actual value of the external device.

This difference depends on tolerances in the I/O board and the external device.

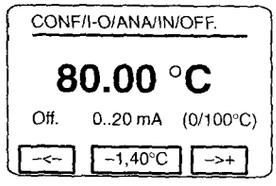
By setting an offset value, the value (i.e. a voltage or a current, respectively) on the external device can be adjusted to the temperature shown on the display of the circulator.



E.g.: current output with 0...20 mA = 0...100°C (channel 5) is selected. On the external device 8.0 V is set to give a set temperature of 80°C. On the display of the circulator the actual temperature 80.00°C is shown. (The actual temperature is always in the centre of the display.)



Due to some tolerance, the actual temperature on external device is not 80.00°C but 81.40°C.



This difference can be adjusted with an offset of −1.40°C.

To set the offset get back to the OUTPUT menu with the MENU key and there select OFFSET.

In the OFFSET menu you can set the offset value (i.e. the difference between the two temperatures) with the arrow keys ← and →.

After this, the value on the external device and the set temperature on the display of the circulator are adjusted.

Confirm with ENTER to save the offset value.

On the display the voltage or current range of the selected mode is shown (e.g. 0...20 mA, 0/100°C). For each channel an offset value can be saved.

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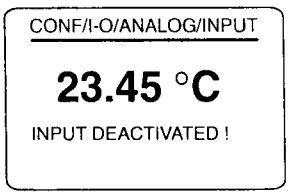
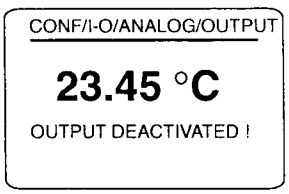
23.4 Simultaneous operation of input and output

Via the I/O plug you can either

- give set values (voltage or current input),
- monitor actual values (voltage or current output) or
- simultaneously give set values and monitor actual values. In this case, input and output channels can be combined at will (e.g. channel 0 for input and channel 7 for output).





23.5 Stopping the input via the I/O plug

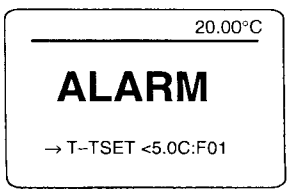
To stop the operation of the analog I/O plug, select STOP in the INPUT or OUTPUT menu, respectively, and confirm with ENTER. The message "INPUT DEACTIVATED !" or "OUTPUT DEACTIVATED !" is shown.

23.6 Starting by means of the timer (only F8 and N8)

The operation of the unit with the I/O plug can be started by means of the timer that is built into circulators of the F8 and N8 line.

To do so the timer has to be set first. Before reaching the start time of the timer the parameters of the I/O plug can be set.

At the start time of the timer, the unit is started as are the input or output of data via the I/O plug.



23.7 Fault display F01

If the circulator switches off this can cause a heavily disturbed voltage or current signal. Please ensure that the deviation of voltage or current is smaller than the equivalent of 0,1°C.

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